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UNIVERSITE SAVOIE MONT BLANC

DOCTORAT EN SCIENCES DE GESTION

**The impact of emotions on individual creativity:
from an intrapersonal to an interpersonal perspective**

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GENERAL INTRODUCTION

1. DISSERTATION OVERVIEW

This research explores the emotion-creativity relationship (see figure 1). More specifically, this work explores the effect of emotions on creativity at an intrapersonal level (i.e., when individuals experience their own emotions) and interpersonal level (i.e., when individuals face leaders who express emotions). At the intrapersonal level, prior research has explored intensively the effect of emotions that individuals experience daily on their creative performance and the boundary conditions of such effect (Baas et al., 2008; Davis, 2009). Two meta-analyses show how emotions represent a determinant predictor of creativity, moderated by properties such as their valence (positive vs negative) or their activation (the level of energy they trigger). Moreover, Davis (2009) shows that the difference of effect between positive and negative emotions occurs only in specific conditions, i.e. ideation and timed tasks. However, a scientific consensus is lacking concerning the mechanisms of such relationship, as studies in the literature suggest that positive and negative emotions lead to creativity through different mechanisms (De Dreu, Baas, et al., 2008; Nijstad et al., 2010). To clarify the underlying mechanisms of the emotion-creativity relationship at the intrapersonal level, a meta-analysis on the complex relationship between individuals' emotions and their creative performance was conducted. This meta-analysis is based on 327 independent samples and 158 studies. Drawing on the Dual Pathway Creativity Model (DPCM) (De Dreu, Baas, et al., 2008), the conceptual model posits that cognitive flexibility (i.e., the ability to switch between various perspectives) and cognitive persistence (i.e., the ability to sustain prolonged effort) mediate the impact of emotions on individuals' creativity. Results support this conceptualization. More specifically, the findings show that activating positive emotions lead to creativity through cognitive flexibility while activating negative emotions triggers creativity through cognitive persistence. These findings contribute to the literature on emotions and creativity (Nijstad et al., 2010; To

& Fisher, 2019) by establishing a scientific consensus about the mechanisms of the emotion-creativity relationship and by resolving inconsistencies in the literature.

An investigation on the more recent research topic related to the emotion-creativity relationship at the interpersonal level (Van Kleef, 2016) complements these meta-analyses on the intrapersonal level. Leaders' emotional expressions are well known to be a powerful source of influence (van Kleef & Côté, 2021). Leaders' emotional expressions reflect their commitment and their motivation to achieve a certain objective, making them perceived as more effective (Humphrey et al, 2008). Yet, the effect of leaders' emotional expressions on individuals' creativity has been poorly investigated (Miron-Spektor et al., 2011; Van Kleef, Anastasopoulou, et al., 2010; Visser et al., 2013). Therefore, the second critical investigation was to understand the effect of leaders' emotional expressions on individuals' creative performance. Using an experimental vignette methodology (Aguinis & Bradley, 2014), the effects of ambivalence, happiness and anger expression are compared. Two laboratory experiments show that idea variety (i.e., number of categories of ideas) and idea quantity (i.e., number of ideas) increase more when individuals receive creativity instructions from an angry leader than from a happy leader (study 1; N=146). In contrast, individuals generate more novel ideas (i.e., with a higher degree of novelty) with a happy leader than with an angry leader. Moreover, idea variety and idea quantity decrease when individuals receive instructions from an ambivalent leader than from a happy leader (Study 2; N=194). This research contributes to the creativity literature (Miron-Spektor et al., 2011; Van Kleef, Anastasopoulou, et al., 2010; Visser et al., 2013), by providing a clear and robust comparison of the effect of the leaders' emotional expressions in creativity instructions. In addition, this research extends EASI (Emotion As a Social Information) theory (Van Kleef, 2009) through the study of the effect of a mixed emotion that is ambivalence. Finally, this article contributes to the literature in leadership (Hughes et al., 2018), by focusing on leaders' emotional expressions as an essential component

of leadership. This research provides practical implications about the emotional strategies and competencies leaders should build at the workplace to enhance individuals' creativity.

Finally, a third (and last) research project was conducted regarding the emotion-creativity relationship in an online context. Although prior research has mainly investigated leaders' expression of emotions during face-to-face interactions (Visser et al., 2013), the impact of leaders' emotions in an online context has been rarely studied (Cheshin et al., 2011). Therefore, the third article of this thesis aims at better understanding the effect of leaders' emotional expressions on participation in *crowd-science* projects. To resolve complex scientific challenges, scientists increasingly collaborate with online communities through text-based communication (e.g., electronic mail messages, forum). However, maintaining a high level of participation in crowd-science projects is difficult (Ali-Khan et al., 2017). This research is based on Polymath, a crowd-science project where professional and non-professional mathematicians collaborate to solve very difficult problems. Drawing on EASI Theory, the influence of leaders' emotions on subsequent participation is explored with a multi-level count analysis. More specifically, this research investigates how leaders' positive emotions influence participation through affective processes and how leaders' negative emotions influence participation through cognitive processes. Results suggest that (1) leaders' positive emotions have a positive relationship through participants' positive emotions with participation's quantity and quality, and (2) leaders' negative emotions have a negative relationship through participants' cognitive complexity (i.e., the extent to which individuals differentiate between multiple competing solutions). By examining the role of leaders' affective dimension in crowd-science projects, this research brings theoretical contributions to crowd science and online community leadership literatures. This research also extends the EASI theory (Van Kleef, 2009) by exploring its mechanisms, through its application in online text-based communication contexts and highlights the importance of emotional intensity.

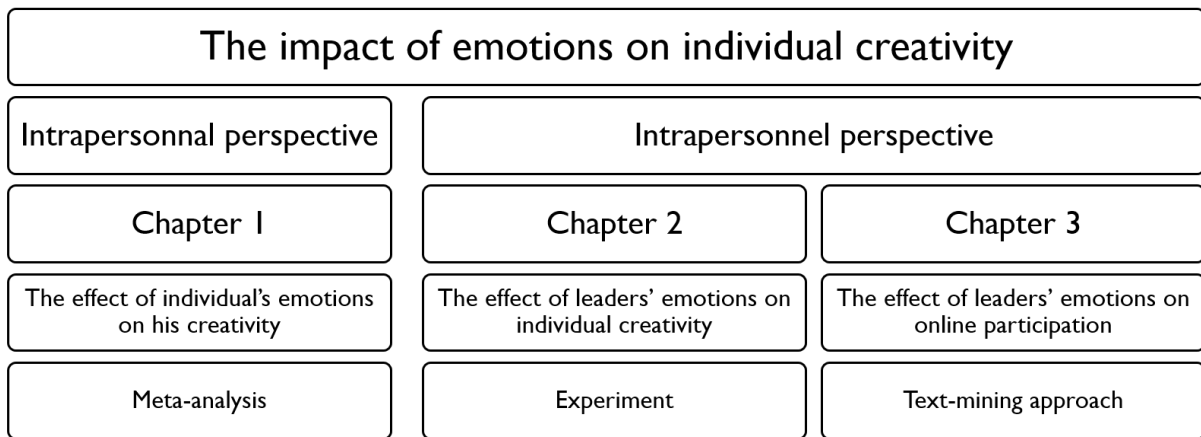


Figure 1. Dissertation overview

2. THEORETICAL BACKGROUND

2.1 DEFINITION OF KEY CONCEPTS

To refer to emotional phenomena, scientists have used various terms. As Van Kleef et al. (2011) pointed out, the most common ones are affect, mood and emotions, and it is essential to make a clear distinction before beginning the discussion. Emotions and mood are two different types of feeling states (P. E. Ekman & Davidson, 1994). A clear difference is that emotions are directed to a certain stimulus (e.g., a concern, a goal, an event, a person) contrary to moods. Also, “Emotions are also comparatively short-lived and intense, whereas moods tend to be more enduring and mild” (Van Kleef et al., 2011, p.312). Emotions are more specific (happiness, anger) than moods (cheerful, depressive). Affect includes these two states and represents individual dispositions that are more general and stable, such as positive or negative affect (Watson et al., 1988).

2.2 EMOTIONS AND CREATIVITY: INTRAPERSONAL LEVEL

Prior scholars show that emotions play a determinant role in shaping creativity (Amabile & Pratt, 2016; To & Fisher, 2019), which is vital for organizational success and survival (Amabile, 1996; Woodman et al., 1993). They also demonstrated that the effect of people’s feelings on their own creativity is complex (Baas, 2019). Scholars argued that examining such effect by comparing positive vs negative emotions (Baas et al., 2008; Davis, 2009) is restrictive

and limits our understanding. Several properties of these feelings play a moderating role (Baas et al., 2008; Davis, 2009).

First, activation (i.e., the level of energy triggered by feelings) is shown to facilitate creativity (Baas et al., 2008). Depending on both valence and activation, the effect of emotions on creativity seems to be triggered by different mechanisms (De Dreu, Baas, et al., 2008). On one hand, activating positive emotions (e.g. positive emotions triggering high level of energy) lead to creativity through cognitive flexibility (i.e. the skill to alternate between various perspectives). People experiencing such emotions tend to feel psychologically more safe, which allows them to explore more possibilities (De Dreu, Baas, et al., 2008; Nijstad et al., 2010). On the other hand, active negative emotions (e.g., negative emotions triggering high level of energy) lead to creativity through cognitive persistence (i.e. sustained effort and focused attention). People experiencing such emotions use more analytical information processing and are less distracted, narrowing their attention (De Dreu, Baas, et al., 2008; Dreisbach & Goschke, 2004). Through this effortful incremental search, individuals can reach creativity after going through initial non-novel ideas (Nijstad et al., 2010; Simonton, 1997).

Second, the regulatory focus perspective moderates these two pathways (Higgins, 2000, Baas, 2008). The regulatory focus theory encompasses two perspectives: promotion-focused or prevention-focused emotion (Higgins, 2000). When experiencing promotion-focused emotions, individuals seek a desired end-state such as realizing a task associated with a reward. Under promotion-focused emotions, individuals are oriented towards accomplishments and aspirations. They feel joy at succeeding in the task but anger and frustration when they do not. Under such emotions, it seems that promotion triggers cognitive flexibility as they broaden the focus of attention (Baas, 2019; Friedman & Förster, 2010; Roskes et al., 2012). When experiencing prevention-focused emotions, the end-state is undesired, such as the non-realization of a task associated with a punishment. The individual is thus more oriented towards

responsibility and safety (To & Fisher, 2019). In that case, prior research finds that prevention triggers cognitive persistence (Baas, 2019; Nijstad et al., 2010; Roskes et al., 2012)

In sum, prior research has intensively explored the complex relationship between emotions and creativity (Baas, 2019; To & Fisher, 2019). However, the role of emotions in enhancing creativity cannot be restricted to the intrapersonal level as individuals express emotions on a daily basis and influence each other's behavior and performance (van Kleef & Côté, 2021). Therefore, the next section presents how emotions can influence creativity from an interpersonal perspective. After presenting the EASI theory, the next section examines how leaders' emotional expressions influence observers' behavior and performance, and more precisely individuals' creativity.

2.3 EMOTIONS AND CREATIVITY: INTERPERSONAL LEVEL

2.3.1 EASI Theory presentation

As emotions are part of our human condition, they have an important role in shaping our behavior, performance, and social interactions. Our decisions and actions are influenced not only by the emotions we experience but also by the emotions we observe from people around us. Emotional expressions contribute to regulate social interactions, as they help individuals to relate to one another: in everyday-life situations, people use emotional expressions as clues to express their own emotions and their motivations, or to decode others' feelings and intentions. Not only individuals use emotional expressions to make sense of ambiguous social situations but they also use them to influence one another. One's emotional expression can shape the emotions, the cognition and the behavior of another person. Scholars then devoted their effort to study the social role of emotions in shaping for instance group coordination, conflict and negotiation, consumer behavior and customer service, or leadership. In his attempt to understand the mechanisms and the boundaries of emotional influence Van Kleef (2009) proposed an integrative theoretical framework called the EASI theory. He

proposed the interpersonal effects of emotions include two mechanisms: either affective reactions or inferential processes in observers (see figure 2).

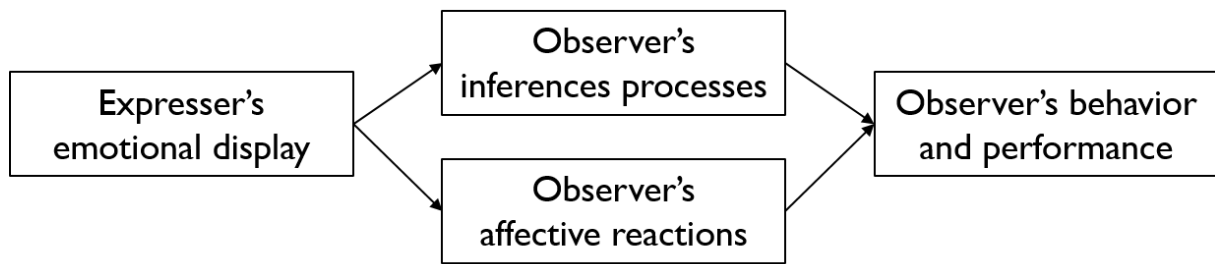


Figure 2. Emotion As a Social Information theoretical framework (Van Kleef, 2009)

2.3.2 First mechanism: affective reactions

First, emotional expressions can influence behavior and performance through the affective reactions of observers, such as complementary or reciprocal feelings. For instance, an individual seeing another person expressing distress can experience reciprocal feelings of distress, or complementary feelings of compassion. In the case of reciprocal feelings, the phenomena of “emotional contagion” (Barsade, 2002) is responsible of such mechanism. This notion reflects the tendency of people being able to experience the emotions displayed in a social interaction. Emotional contagion tends to happen automatically. Individuals exposed to others’ emotional expressions tend to mimic unconsciously and produce the corresponding emotional states. Emotional contagion can occur through text-based communication (Cheshin et al., 2011). Emotional expressions can trigger complementary but matching emotional states as well, as an observer seeing a person expressing anger can experience fear for instance, or an observer seeing a sad person can experience sympathy.

Consequently, affective reactions will influence one’s cognition, motivation and behavior (Van Kleef, De Dreu, et al., 2010). For instance, prior research in experienced emotions and creativity shows that individuals feeling happy will have a better creativity than individuals experiencing neutral emotion, because of triggered cognitive flexibility (De Dreu, Baas, et al., 2008). Furthermore, affective reactions can also have an influence on the judgment

that people make (Forgas & Bower, 1988; Isen, 1987), as positive (negative) emotional states help to access to positive (negative) cognitions, which lead to more prosocial (adversarial) judgments. Moreover, individuals tend to develop impressions based on the emotions they express, hence shaping the social interactions (Clark et al., 1996; Clark & Taraban, 1991). In sum, emotional expressions can shape observers' behaviors though triggered affective reactions, emotional mechanisms that will in the end influence their cognition, sometimes unconsciously.

2.3.3 Second mechanism: cognitive inferences

Second, emotional expressions can influence behavior and performance through the inferences processes of observers: individuals observing emotional expressions can draw inferences via cognitive efforts (Van Kleef, 2009). Individuals can use emotional expressions they observe as clues to draw conclusions about the situation or about the expresser, as they can understand better how the expresser feels (Ekman, 1993), his social motivations (Fridlund, 2014), or his reaction regarding the situation at hand (Manstead & Fischer, 2001). In the end, emotional expressions carry an informational value that observers can use to get clues specific to the situation (Van Kleef, 2009). That being said, emotional expressions of discrete emotions carry specific meaning across situations: for instance, expression of happiness signals that a significant step towards a goal has been realized, while expression of anger signals goal obstacles and problems (Van Kleef, 2016). However, for observers to be able to draw inferences from emotional expressions, it remains necessary to provide deliberate and effortful information processing, as it requires some cognitive resources in terms of attention (Van Kleef, De Dreu, et al., 2010).

Consequently, through the informational value they carry, emotional expressions have an effect on the behavior of observers (Van Kleef, 2009). More specifically, the relationship between the person expressing and the person observing the emotional expression plays a

determinant role in shaping such effect (Van Kleef, 2016). The higher the interdependence between the expresser and the observer, the more influential the consequences on observer's behavior (Rusbult & Van Lange, 2003). Moreover, the perception of a situation as competitive (e.g., in a negotiation) or as cooperative (e.g., common goal in a team project) will also influence the effect of emotional expressions, so that the informational value of a specific displayed emotion can result in different possible observer's behaviors (Van Kleef, De Dreu, et al., 2010). For instance, a happy emotional expression in a cooperative or in a competitive context would result in different observer's behaviors.

In summary, one's emotional expressions influence observers' behaviors through two mechanisms, affective reactions and inferences processes, and such mediators seem to be independent to one another (Van Kleef et al., 2011): they belong to two different types of processes, affective and cognitive respectively (Zajonc, 1980), to two different brain areas (Salzman & Fusi, 2010), and to two types of conceptual operationalization, sentiments and information respectively (Van Kleef, 2016). However, even though these processes are independent, some factors can make the effect of emotional expressions prioritize one pathway over the other, establishing boundary conditions (see table 1) on the social influence of emotions.

2.3.4 Boundary conditions

Prerequisites

- Expresser's emotional expressivity
- Observer's emotion perception ability

Moderators

- Observer's information processing
 - Epistemic motivation
 - Processing capacity
- Perceived appropriateness of the situation
 - Situational characteristics ➤ Cultural norms, organizational rules, degree of cooperativeness vs competitiveness
 - Expression characteristics ➤ Valence, authenticity, intensity, target
 - Expresser characteristics ➤ Stereotypes: gender, status, group membership
 - Observer characteristics ➤ Personality traits: agreeableness, extraversion, neuroticism

Table 1. Moderators of the effect of emotional expressions

2.3.4.1 Prerequisites

Emotional expressions require several prerequisites to influence behavior and performance. For instance, on one side, such influence depends on people's tendencies to display emotions or not (Van Kleef, 2016). Individuals tend to share their emotions differently due to differences in emotional expressivity (Gross & John, 1997): for the same experienced feeling intensity, people seem to display the corresponding emotion at different degrees, depending on their personality, their organization rules and the social situation. Moreover, on the other side, the social effect of emotions depends also on the ability of people to decode emotional expressions (van Kleef & Côté, 2021): due to individual differences in emotional intelligence (Salovey & Mayer, 1990), people tend to have different skills regarding the recognition of emotions. Individuals tend to perceive and distinguish emotions with a difference in accuracy, which can moderate their social responding to emotional expressions (Elfenbein et

al., 2007). Then, the way individuals express and decode emotional expressions shapes their social effects on performance and behavior. More specifically, the match between the degree to which an expresser displays his emotions and the degree of sensitivity to which an observer recognizes emotional expressions shapes their social effects (Van Kleef, 2016).

2.3.4.2 Epistemic motivation

Following these prerequisites, other factors tend to moderate the effect of emotional expressions on behavior and performance (van Kleef & Côté, 2021). First, observers' information processing determines whether affective reactions or inferences processes will mediate the effect of emotional displays (Van Kleef, 2009). As said above, one's emotional expressions influence observers' behavior either through affective processes, emotional mechanism with superficial or unconscious information processing, or through inferences process, in which observers need to invest cognitive resources and efforts to analyse the information value of emotional expressions (Van Kleef, 2016). In other words, as long as observers recognize emotional expressions, affective reactions can easily occur while inference processes require conscious cognitive effort (Van Kleef, De Dreu, et al., 2010). Such tendency to spend effort to analyze emotional expressions is operationalized through the concept of epistemic motivation; i.e. the motivation in devoting energy to better understand the world (Kruglanski, 1989). In an ambiguous social situation, an observer with high epistemic motivation will consider he lacks information and will attempt to compensate by the deliberate effort in analyzing emotional expressions (De Dreu, Nijstad, et al., 2008; Kruglanski, 1989). Observers with low epistemic motivation are then less subject to consider they lack information, resulting in superficial information processing and affective reactions (van Kleef & Côté, 2021). Moreover, this motivation goes in pair with observers' processing capacity, as not only their effort but also their ability to process information will influence their inferences processes (Chaiken, 1980; Chaiken & Trope, 1999). This ability depends not only on individual

differences such as intelligence or working memory capacity (Conway et al., 2002; Van Kleef, 2016) but also on situational variations, such as cognitive load and mental fatigue, which undermine information processing and facilitate affective reactions (Gilbert & Hixon, 1991).

2.3.4.3 Perceived appropriateness

Second, factors regarding the fit between emotional expressions and the norms shape the effect of such emotional expressions. More specifically, how observers perceive the emotional displays as appropriate or not depending on the situation plays a determinant role in shaping their behavior and performance (van Kleef & Côté, 2021). For instance, expressers can display the wrong emotion regarding a specific social context or the right emotion at too high intensity (Shields, 2005). Contrary to epistemic motivation, a factor related to individual differences in personality, perceived inappropriateness is a factor related to political dimensions (Parrott, 2001). Observers perceive inappropriateness depending on the rules and cultural norms of the situation, they will give less credibility to emotional expressions they consider inappropriate, will spend less effort in trying to analyze them, undermining a potential behavioral change (Van Kleef, 2009). Various social-contextual factors shape what makes a situation perceived as inappropriate, for instance the characteristics of the situation, in terms of cultural norms and in terms of degree cooperativeness vs competitiveness (Van Kleef, 2016).

Rules in a social context determine how individuals should express emotions, often in a tacit way (Johnson et al., 1975), and are dependent on the culture they are embedded with (Van Kleef, 2016). For instance, depending on individuals living in a collectivistic or individualistic culture, the perceptions of inappropriateness of emotional expressions: for instance, individuals will see anger expressions as a sign of assertiveness in individualistic cultures, while they will interpret such display as a sign of group harmony threat in collectivistic ones (Matsumoto, 1990; Van Kleef, 2016), undermining voluntary behavior (Koning & Van Kleef, 2015). Rules regarding emotional displays relate to organizational norms, as individuals working in customer

service industries will have guidelines regarding emotions they can express or not (Grandey et al., 2005). Expectations regarding emotional expressions are dependent on the degree of cooperation vs competition between the expresser and the observer, as individuals would tolerate an attempt of domination on a competitive context while they would expect harmony in a cooperative setting (Van Kleef et al., 2011). Moreover, how individuals perceive emotional displays as inappropriate or not depends not only on situational characteristics, but also on the fit with the properties of the emotional expression itself.

In most situations, not surprisingly, observers receive positive emotional expressions better than negative emotional expressions (Shields, 2005; Van Kleef, 2016). However, not only the valence of the emotional expression shapes observers' perception of inappropriateness, but also other properties, such as the degree of authenticity (Van Kleef, 2016). To respect emotional display rules or to have a better influence on observers strategically, individuals may have to express more or less emotions compared to what they really feel (Côté, 2005). Observers may perceive this dissonance and consider it as inappropriate, since they can evaluate this emotional display as an untrustworthy attempt to manipulate them (Côté et al., 2013). Such perceived as manipulative emotional expressions could result in less support and lower quality social relationships and trust (Van Kleef, 2016). Emotional intensity is another characteristic of emotional expression shaping observers' perception of inappropriateness (van Kleef & Côté, 2021): the intensity of emotions can exceed expectations and individuals can then perceive emotional expressions as inappropriate (Shields, 2005; Van Kleef et al., 2012). For the same emotional display, depending on the intensity, one can obtain smaller or larger concessions in a negotiation (Adam & Brett, 2018) or different customer service satisfaction levels (Cheshin et al., 2018). Moreover, a last characteristic of emotional expression influencing observers' perception of inappropriateness would be the target of emotional expression (Van Kleef, 2009),

as people would perceive as inappropriate being the unfair target of anger expression for instance (Van Kleef, 2016).

Characteristics of the expresser of emotions also contribute to shape the perceived inappropriateness of the observer, such stereotypes playing a determinant role (van Kleef & Côté, 2021). For instance, the gender of the expresser can affect observer's perception of expresser's emotional expression, since across cultures stereotypes tend to associate men to "dominant" emotions such as anger and women to soft" emotions such as sadness (Plant et al., 2000; Shields, 2005). Another characteristic of the expresser influencing the perception of inappropriateness is if the expresser is sharing the same group membership as the observer or not (Van Kleef, 2016): an observer will tend to considerate more attentively the emotional expressions of ingroup member and to considerate as more inappropriate the emotional expressions of an outgroup member, all else being equal (Shields, 2005). In addition, another determinant characteristic of the expresser affecting perceived inappropriateness is his social hierarchy, as observers tend to expect leaders to express anger and pride for negative and positive outcomes respectively, while they tend to think that "supplication" emotions such as sadness should be displayed by people with lower hierarchy (Tiedens, 2001; Van Kleef, 2016).

Finally, personality characteristics specifics to the observers tend to shape how appropriate they perceive emotional expressions (Van Kleef, 2009). For instance, considering the personality traits of agreeableness, high-agreeableness observers, who aim for social harmony, tend to have low tolerance regarding anger expression, as they prefer to avoid conflict (McCrae & Costa, 1987; Van Kleef, 2016). On the contrary, considering the personality trait of extraversion, extravert individuals value others' emotional expressions and tolerate emotional expressions of high intensity more easily, contrary to introvert individuals who can consider rapidly intense emotional expressions as inappropriate (Costa & McCrae, 1988). In addition, individuals high in neuroticism, or in other words more subjects to experience anxiety and

depression, tolerate more other people displaying similar emotions, since such display relates to their own feelings (McCrae & Costa, 1987).

In sum, the EASI theory states that one's emotional expressions can influence observer's behavior through affective reactions or inferences processes (Van Kleef, 2009). As prerequisites for such influence to occur, emotional expressivity and the ability of observers to decode emotions are necessary. Moreover, several categories of moderators make this theory quite context-dependant (Van Kleef, 2016), as observers' epistemic motivation and their processing capacity, as well as how inappropriate observers perceive emotional expressions. Such perception depends as well on various properties, such as the characteristics of the situation (cultural norms, organizational rules, the degree of cooperativeness vs competitiveness), of the expression (authenticity, intensity, target), of the expresser (stereotypes related to gender, group membership or status) or the characteristics of the observer (personality traits such as agreeableness, extraversion or neuroticism).

2.3.5 Leadership and emotional expressions

When controlled, emotional expressions become a great source of influence and an essential part of leadership (Côté, 2011; Van Kleef, 2016). As leaders need to influence individuals for organizational performance, emotional expressions having a stronger influence than the content of leaders' arguments might occur (Newcombe & Ashkanasy, 2002). Not only leaders' emotional expressions might influence observers' perceptions of leadership effectiveness, but also observers' objective performance (Van Kleef, 2016).

First, as emotional expressions give clues to observers about the social context, followers tend to support leaders displaying emotions, as they perceive expressive leaders as more committed to the vision of the company (Van Kleef, De Dreu, et al., 2010). Moreover, not surprisingly, it seems that followers prefer leaders expressing positive rather than negative emotions, as they perceive positive leaders as more charismatic (Bono & Ilies, 2006; Damen et

al., 2008; van Knippenberg & van Kleef, 2016). In terms of mediation, positive affective reactions explain such preference, as leaders' positive displays increase interpersonal liking (Bono & Ilies, 2006) and emotional contagion, making followers "catch" the positive emotions displayed by leaders (Chi et al., 2011; Sy et al., 2005). However, as described above, the effect of leaders' emotional expressions is subject to boundary conditions, one of them being the target of the emotional display (Van Kleef, 2009). For instance, a follower, observing a leader's anger expression toward a third party who did not respect his engagement, can become motivated as he is not the target of such emotional expression (Van Kleef, 2016). As a leader displaying anger represents a sign of aggression, followers can also perceive such leaders as decisive and competent (Tiedens, 2001), as long as such emotional expressions respect organizational norms (Van Kleef et al., 2012).

Second, more interestingly, the effect of leaders' emotional expressions on follower's performance does not seem to follow such a clear distinction between positive leaders enhancing better performance than negative leaders (van Knippenberg & van Kleef, 2016). Of course, positive leaders can trigger performance compared to negative ones (Gaddis et al., 2004; Johnson, 2009), however, independently of the liking of the followers, negative leaders can provoke followers' performance, as they can perceive leaders' negative emotional expressions as a sign that high expectations performance (van Doorn et al., 2014; van Knippenberg & van Kleef, 2016). In coherence with the theory, boundary conditions moderate the effect of leaders' emotional expressions on performance, and a crucial moderator is the performance criterion (van Knippenberg & van Kleef, 2016). For instance, leaders' positive emotional expressions can trigger teams' positive feelings, which improve their coordination, while leaders' negative emotional expressions can trigger teams' negative feelings, which improve their effort (Sy et al., 2005). In addition, leaders often express anger in construction industry to finish the tasks in due time (Lindebaum & Fielden, 2011).

Another moderator influencing the effect of leaders' emotional expressions on performance is followers' emotional processing (Van Kleef, 2009): as described earlier, leaders' emotional expressions influence observers with low epistemic motivation through affective reactions, while leaders' emotional expressions influence observers with high epistemic motivation through inferences processes. Therefore, (Van Kleef et al., 2009) demonstrated that leaders' expressions of happiness increased performance of teams with low epistemic motivation through emotional contagion (team's feelings of happiness and liking of the leader) while leaders' expressions of anger increased performance of teams with high epistemic motivation through inferences processes (high performance expectations). Similar studies also showed that negative emotional expressions increased performance with high epistemic motivation followers, as they interpreted such emotional displays as a call for a higher performance (Chi & Ho, 2014; Sy et al., 2005; van Kleef, 2014).

How appropriate followers consider leaders' emotional expressions moderates the social effect of emotions as well (Van Kleef, 2016). For instance, in a voluntary context, followers would perceive leaders' anger expression as less appropriate than in a company setting, which would decrease followers' organizational citizenship behavior (Koning & Van Kleef, 2015). In this case, as followers are offering their help and not accomplishing a task by obligation, leaders' anger expression would only result in damaging the relationship with the leader, with no motivational boost. Similarly, considering trait personalities, high agreeableness followers, i.e. with a strong inclination towards social harmony, deliver better motivation and performance with a happy leader, while for low-agreeableness followers such motivation and performance occur with an angry leader (van Kleef, 2014; Van Kleef, Homan, et al., 2010). Depending on the cultural background, these results might reverse, as high-agreeable followers from collectivistic and individualistic culture would perceive the appropriateness of anger expression differently (Chi & Ho, 2014).

As studies following the EASI theory (Van Kleef, 2009) mainly have focused on single emotions such as happiness and anger, i.e. emotions that are only positive or only negative, (Van Kleef, 2016) insists on the need to explore the effect of expressing mixed emotions, i.e. experiencing simultaneously both positive and negative emotions (Fong, 2006; Larsen & McGraw, 2014). An emerging current of literature began to explore the effect of leaders' expressions of emotional complexity, showing how such leaders' expressions can empower employees to act more proactively (Rothman & Melwani, 2017). Future studies remain needed to better understand the effect of expressing mixed emotions (Van Kleef, 2016).

2.3.6 Leaders' emotional expressions and creativity performance

As indicated by To and colleagues (2019), research works about the effect of leaders' emotional expressions on other individuals' creativity remain rare. Empirical record show that leaders expressing happiness during task instructions enhance individuals' creativity performance better than leaders expressing sadness, through affective reactions (Visser et al., 2013). More precisely, consistent with theory (Van Kleef, 2009), emotional contagion explains such effect: followers feeling the happiness displayed by the leader (Barsade, 2002) will see their cognitive flexibility enhanced as well as their creativity (De Dreu, Baas, et al., 2008) compared to followers feeling the sadness displayed by the leader (Visser et al., 2013). In another laboratory study, Miron-Spektor et al. (2011) showed that customers expressing anger through sarcasm will enhance the capacity of participants to resolve creative problems through their prevention orientation. Consistent with theory (Van Kleef, 2009), Van Kleef, Anastasopoulou et al. (2010) demonstrated the moderating role of epistemic motivation: compared to neutral emotions, leaders expressing anger in their feedbacks enhance high epistemic motivation followers' creative performance through creative process engagement, such followers interpreting leaders' anger expression as a sign of higher performance expectation. Overall, results show that the influence of emotional expressions on individuals'

creativity seems to be moderated by epistemic motivation (Van Kleef, 2009), and that expressions of happiness and anger (in particular settings) potentially benefit individuals' creativity. However, it still remains unclear which emotion enhances the most creativity.

3. EPISTEMOLOGICAL POSITIONING AND RESEARCH METHODOLOGY

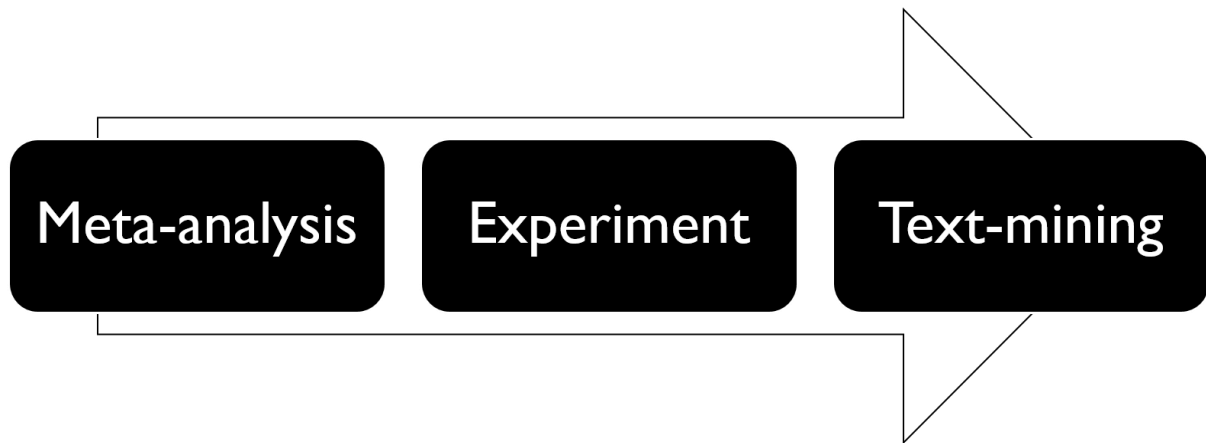


Figure 3. Methods used to investigate the emotion-creativity relationship

Globally, this research adopted a positivist epistemology (Gavard-Perret, 2012). In that sense, the researcher is completely independent from the phenomena under investigation, and tries to understand what the laws that rule the phenomenon are. For instance, this research attempts to better understand the laws that rule the emotions-creativity relationship. Such investigation requires a hypothetico-deductive approach, in which refutable hypotheses are tested to confirm theory with a quantitative perspective, i.e. with a quantifiable error margin. Such hypothetico-deductive approach with a quantitative approach allows fits with the object of investigation of this research, i.e. the effect of emotions on individual creativity. In other words, as this work explores a general effect between two phenomena, a quantitative perspective is appropriate and puts in evidence correlated variations between two phenomena (Gavard-Perret, 2012).

This research took a multi-methodological approach (see figure 3) to investigate the effect of emotions on individual creativity. First, in order to summarize and analyse the body of research about such effect from an intrapersonal perspective, a meta-analysis was conducted.

Such structured research technique allows to summarize findings more sophisticatedly than conventional reviews, as meta-analyses review also non-significant results (Lipsey & Aiken, 1990; Schmidt, 1992) and as qualitative reviews limit the possible level of scrutiny of the differences between the findings and the number of studies involved (Lipsey & Wilson, 2001).

Second, in order to establish causality between two emotions and individual creativity, this research uses laboratory experimental methods (Cook et al., 2002), which help to investigate if between different groups, there is a difference in the variable of interest. By ensuring randomization assignments, this research guarantees internal validity of the claimed results, and by implementing experimental vignette methodology with video vignettes and increasing realism (Aguinis & Bradley, 2014), this research provides more external validity and similar effects than those from field studies.

Finally, this work uses text-mining approach to access to online text as a great source of semantic content and valuable knowledge and to extract quantitative information from it (Zhai & Massung, 2016). In that regard, this research used LIWC (Linguistic Inquiry Word Count), a text-based application that quantifies underlying linguistic, cognitive or emotional dimensions from textual data (Pennebaker et al., 2015). Values given as an output for a specific dimension reflects the percentage of words corresponding to that dimension in the textual input. This application contains 2300 words and independent judges established their correspondence with 68 psychological dimensions. Using this approach, this research explores the effect of emotions through text-based communication.

Using these different methodologies, this research investigates in the next sections the effect of emotions on individual creativity and details three principal results. First, from an intrapersonal perspective and using a meta-analysis approach, results show that when individuals' activating positive emotions lead to creativity through cognitive flexibility while their activating negative emotions lead to creativity through cognitive persistence. Then, after

having demonstrated how individuals' emotions shape their creativity, this research moves from an intrapersonal to an interpersonal perspective. Results show that, in face-to-face interactions, leaders should express happiness or ambivalence to enhance individuals' creativity. Finally, this work moves to text-based-communication settings and investigates the mechanisms through which leaders' emotional expressions influence participation in online communities. Results demonstrate that leaders' expressions of positive emotions trigger individuals' participation through affective processes while leaders' expressions of negative emotions trigger individuals' participation through cognitive processes. Overall, this research uses different methodologies and moves from an intrapersonal to an interpersonal perspective to show how emotions play a determinant role in shaping individual creativity.

CHAPTER I: HOW DO EMOTIONS IMPACT CREATIVITY? A META-ANALYSIS OF DUAL PATHWAY CREATIVITY MODEL

I.1 ABSTRACT

Creativity is not only a cognitively complex activity but also an emotionally charged one. Emotions are known to be a strong predictor of creativity. Yet, there is no scientific consensus about the mechanisms underlying the effect of emotions on creativity. Using a meta-analytical approach with 327 independent samples and 158 studies and following the DPCM, this research examines how cognitive flexibility (i.e., ability to switch between different perspectives) and cognitive persistence (i.e., ability to sustain and focused task-directed cognitive effort) mediate the impact of emotions on the creativity. Results show that activating positive emotions lead to creativity through cognitive flexibility while activating negative emotions trigger creativity through cognitive persistence. Findings contribute to the literature on emotions and creativity by establishing a scientific consensus about the mechanisms of the emotion-creativity relationship and by resolving inconsistencies in the literature. Practically, findings inform managers about the processes under which emotions lead to creativity in the workplace. Limitations and future research are discussed.

I.2 INTRODUCTION

Decades ago, scientists recognized the crucial role of creativity in organizations and the embedded role of emotions in triggering creativity: organizations need to be creative to maintain a competitive advantage, enhance their growth, and survive in dynamic environments (Amabile, 1996). Accordingly, before implementing and achieving innovative outcomes, organizations need to obtain original and useful ideas from their employees (Amabile & Pratt, 2016). Nevertheless, research has shown that coming up with creative ideas is an emotionally charged activity and experiencing emotions plays a large role in shaping this cognitively complex activity (De Dreu et al., 2012; To & Fisher, 2019). Prior meta-analyses showed that positive emotions trigger creativity more than neutral emotions and more than negative emotions in specific conditions (Baas et al., 2008; Davis, 2009). However, the difference of effect between positive and negative emotions is unclear, as inconsistencies remain in the literature. Among other moderators, Baas et al. (2008) established the role of activation, i.e., the level of energy triggered, activating emotions leading to more creativity than deactivating ones.

Yet, there is no scientific consensus about the mechanisms underlying the relationship between emotion and creativity. In their DPCM (De Dreu, Baas, et al., 2008), prior scholars proposed that cognitive flexibility (i.e., ability to switch between various perspectives) and cognitive persistence (i.e., ability to sustain and focused task-directed cognitive effort) represent complementary approaches to explain the effects of emotions on creativity. Several studies show that, compared to deactivating emotions, activating positive emotions lead to creativity through cognitive flexibility, while activating negative emotions leads to creativity through cognitive persistence (Nijstad et al., 2010). As prior meta-analyses focused on demonstrating the emotion-creativity relationship and examining the influence of several moderators, this research tests the DPCM on a meta-analytical level with an exhaustive literature search,

comparing activating emotions to neutral and deactivating emotions. In accordance with DPCM, our analysis with 327 independent samples suggests that (1) activating positive emotions enhance creativity through flexible processing compared to neutral and deactivating emotions, and (2) activating negative emotions lead to creativity through persistence compared to deactivating emotions only.

This research makes important contributions to the literature. First, our results bring a scientific consensus about the mechanisms involved in the emotion-creativity relationship. Second, and crucially, our research resolves the inconsistencies of prior findings. From a managerial perspective, our research helps practitioners determine which emotion facilitate creativity and why. Limitations concerning potential theoretical and methodological moderators are discussed, as well as future work about studying the emotion-creativity relationship through a dynamic perspective.

I.3 THEORITICAL BACKGROUND & HYPOTHESES

Organizations need to be creative to maintain a competitive advantage, enhance their growth, and survive in dynamic environments. Before implementing and achieving innovative outcomes, organizations need to obtain original and useful ideas from their employees (Amabile, 1996). Scholars operationalize creative performance through several dimensions, such as the number of ideas (*Fluency*), the degree of novelty of ideas (*Originality*), or a composite of these two dimensions (*Divergent Thinking*) (Guilford, 1967; Torrance, 1966). Other dimensions such as the supervisor rating of employee's creativity (*Composite*), the resolution of a creative problem (*Convergent Thinking*) with one known solution, such as the Candle's problem (Duncker & Lees, 1945) or the Remote Association Test (Mednick, 1962) represent other facets of creativity performance as well.

According to the Dual Pathway Creativity Model (De Dreu, Baas, et al., 2008), individuals achieve creative performance through two complementary cognitive approaches:

either cognitive flexibility (i.e., “the ease with which people can switch to a different approach or consider a different perspective”), or cognitive persistence (“the degree of sustained and focused task-directed effort”) (Nijstad et al., 2010, p42). On the one hand, individuals need to think flexibly to generate many original ideas (Amabile, 1983; Mednick, 1962). Cognitive flexibility consists in generating various categories of ideas as well as broad and inclusive categories and represents both a measure of creative performance and a cognitive process (Amabile, 1996). Generating many categories of ideas requires to produce many ideas (fluency) as well as rare ideas (originality) (De Dreu et al., 2012). Using a high number of remote associations, such divergent information processing is beneficial for creative performance (Mednick, 1962; Nijstad et al., 2010).

On the other hand, cognitive persistence as a convergent information processing can also benefit creative performance (Baas, 2019): individuals who spend longer time on the task and generate novel ideas through effort. Instead of generating many different ideas, exploring in-depth ideas within a few categories can also lead to novel ideas (De Dreu et al., 2012). In that case, hard work and perseverance through systematic and analytical information processing would enhance the number of ideas and their originality (Lucas & Nordgren, 2015; Nijstad et al., 1999).

Taken together, individuals can thus achieve creativity through both cognitive flexibility and persistence, whether individuals are dealing with divergent and idea generation tasks or insight and problem-solving work, both potentially requiring alternative perspectives or prolonged effort (De Dreu, Baas, et al., 2008). Therefore, following the DPCM, prior research has shown that states that influence cognitive flexibility and persistence lead to higher creative performance (Nijstad et al., 2010). In addition, research has applied this model to one of the most studied predictors of creative performance: emotional states (To & Fisher, 2019).

In exploring the emotion-creativity relationship, researchers have agreed on its complexity (De Dreu et al., 2012; Fong, 2006). Two meta-analyses have focused on the main effect of emotions on creative performance and the moderators of this effect (Baas et al., 2008; Davis, 2009). These two meta-analyses both demonstrated that positive emotions trigger more creativity than neutral emotions. However, Baas et al. (2008) showed no significant effect differences between positive and negative emotions while Davis (2009) find that positive emotions lead to more creativity than negative emotions for timed and ideation tasks. Baas et al. (2008) further showed that the effect of emotion on creativity also depends on their level of activation: activating emotions (e.g., happiness, anger) with high levels of arousal/energy will trigger more creative performance than deactivating emotions (e.g., relaxation, sadness). Thus, these two prior meta-analyses focused on demonstrating the emotion-creativity relationship and examining the influence of several moderators. However, there is still a need to find a scientific consensus about the mediators explaining the effect of emotions on creative performance. To resolve this issue, this paper aims at testing the DPCM (De Dreu et al., 2008) through a meta-analysis perspective.

The DPCM proposes that the effect of emotions on creativity does not only depend on the valence of emotions (positive or negative) but also on their level of activation (high or low level of energy) (De Dreu, Baas, et al., 2008; Nijstad et al., 2010). In general, activating emotions has been found to stimulate creativity more than deactivating emotions. Deactivating emotions would lead to less cognitive activation and arousal, and such inactivity would be detrimental to creativity performance (Baas et al., 2008). In contrast, activating emotions would lead to more creativity through better cognitive functions such as the release of neurotransmitters (dopamine, etc) in the prefrontal cortex, and enhanced working memory capacity and attention (Dreisbach & Goschke, 2004). Moreover, activating emotions increase tasks engagement and motivation, which are beneficial for creative performance as well (De

Dreu et al., 2012). According to the DPCM, activating emotions would thus increase creative performance through different mechanisms depending on the valence of the emotion involved (De Dreu, Baas, et al., 2008).

On the one hand, activating positive emotions increase creative performance through cognitive flexibility (Nijstad et al., 2010). With positive feeling, individuals are more likely to feel safe, to explore different perspectives, and take risks with original ideas (Amabile & Pratt, 2016; George & Zhou, 2007), which increase their cognitive flexibility. Furthermore, experiencing positive emotions will increase the scope of attention, both perceptually and conceptually (Friedman & Förster, 2010), facilitating the holistic and analogical right hemisphere of the brain (Faust & Mashal, 2007; Fink & Neubauer, 2006). Moreover, individuals with positive emotions seem to look for maintaining this emotional state: they make the creativity task more funny by generating many different categories of ideas and they are more motivated to generate original ideas (Hirt et al., 2008). Besides, as cognitive flexibility is also a measure of creative performance, Baas et al. (2008) demonstrated in their meta-analysis that only positive emotions lead to higher flexibility, contrary to negative emotions. Such arguments lead us to the following hypotheses:

H1a: Positive activating emotions are positively associated with creative performance.

H1b: The effect of positive activating emotions on creative performance is partially mediated by individuals' cognitive flexibility.

On the other hand, activating negative emotions increase creative performance through cognitive persistence (Nijstad et al., 2010). Individuals experiencing negative emotions tend to spend more time on the creative task and take it more seriously, increasing their creativity through persistence (Verhaeghen, 2019). They perceive the situation as more problematic and troublesome (De Dreu, Baas, et al., 2008), and as a consequence, they process information in detail, analytically, and systematically (Baas, 2019). Furthermore, experiencing negative

emotions seems to increase focus (De Dreu, Baas, et al., 2008), which narrows the scope of perceptual and conceptual attention (Fredrickson, 1998; Friedman & Förster, 2010), and facilitates the brain’s sequential and analytic left hemisphere (Faust & Mashal, 2007; Fink & Neubauer, 2006). Negative emotions reduce distractibility, trigger risk aversion and promote task engagement (Baas, 2019; De Dreu, Baas, et al., 2008). Therefore, individuals feeling negative emotions can be more creative, not because of enhanced flexibility, but because of in-depth exploration and elaboration thanks to their enhanced cognitive persistence. Therefore, we aim to test the following hypotheses for the cognitive persistence pathway:

H2a: Negative activating emotions are positively associated with creative performance.

H2b: The effect of negative activating emotions on creative performance is partially mediated by individuals’ cognitive persistence.

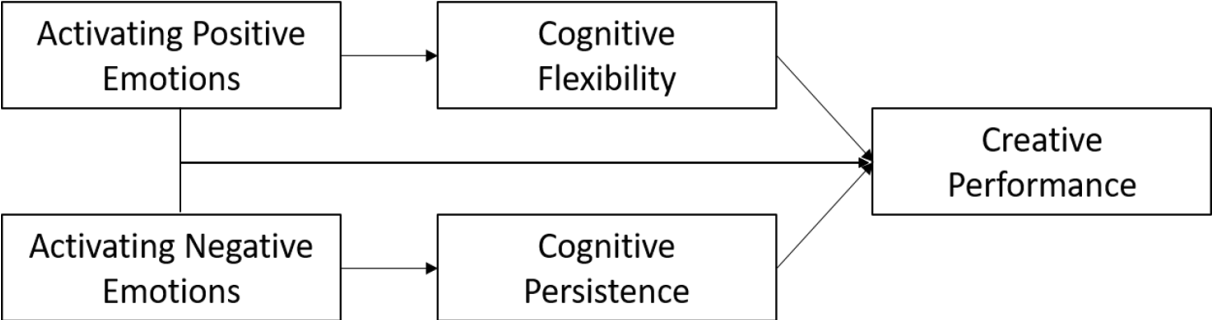


Figure 4. Dual Pathway Creativity Model (De Dreu et al, 2008)

1.4 METHOD

The authors collected data on April 2020 for testing the model described above (Figure 4). Using the inclusion criteria proposed in prior meta-analyses (Baas et al., 2008; Davis, 2009), articles were included if (1) the emotional or mood state was manipulated or measured, (2) the dependant variable was an objective outcome (i.e., not self-reported) or a rating of performance based on a creativity-related task, (3) the sample was from the general non-clinical population (managers, adults, children), and (4) the necessary statistical information to compute effect sizes was provided. Using multiple databases, a search of all published articles meeting these

criteria was realized. Using Scopus, work citing the above-discussed meta-analyses and their constituent articles was selected, as well as the following seminal articles: Greene & Noice, (1988), Isen & Daubman (1984), Isen (1987), Kaufmann & Vosburg (1997) or Murray et al. (1990). Through databases such as Ebsco, Proquest, and PsycInfo, the articles were selected based on keyword searches of article titles (see table 2). Around 10.000 abstracts were collected based on this search. Then, these abstracts were filtered based on the criteria above, and 300 articles were collected for potential computation.

Variable	Keywords
Creativity	creativ* OR innov* OR divergent thinking OR original* OR fluency OR ideational fluency OR flexib* OR flexible thinking OR insight OR remote association OR novel* OR feasib* OR utility OR useful
Mediators	effort OR persistence OR perseverance OR cognitive flexib* OR attention*
Emotion	mood OR emotion* OR affect* OR ang* OR happ* OR anx* OR sad* OR positive OR negative OR ambival* OR mixed emotion OR complex emotion OR regulatory focus OR promotion OR prevention OR regulatory foci OR regulatory fit OR self-regulation OR avoid* motivation* OR approach* motivation*

Table 2. Variable keywords used to search Ebsco, Proquest and PsycInfo databases

Finally, we have computed 327 independent samples for 158 articles. Creativity performance was coded following prior research (De Dreu, Baas, et al., 2008), as the number of ideas (*Fluency*), the degree of novelty of ideas (*Originality*), or a composite (average) of these two dimensions (*Divergent Thinking*) (Guilford, 1967; Torrance, 1966). Creativity was coded also as the supervisor rating of employee’s creativity or the rating of poems or stories (*Composite*), or as the resolution of a creative problem (*Convergent Thinking*) with one known solution, such as the Candle’s problem (Duncker & Lees, 1945; Mednick, 1962). Cognitive flexibility was measured as the number of categories generated during a creative task, as cognitive inclusiveness or breadth of categorization, as breadth of the scope of attention, as mental break set, or as the minimization of cognitive switch costs. Cognitive persistence was measured as the time spent in the task, as the number of ideas divided by the number of

categories, as the degree of elaboration in the generated solutions, or as a narrower categorization or breadth of categorization.

The correlations were coded such that higher degree of activation from emotions indicates better creative performance, compared to neutral and deactivating emotions, using the effect size determination program from Lipsey & Wilson (2001), based on the reports of different parameters such as means and standard deviations, t tests or F ratios. Following the guidelines from Hunter & Schmidt (2004), the correlations were corrected for their reliability using a conservative 0.80 level (Dalton et al., 1998). Then, weighted mean correlations were calculated, considering sample sizes and artifact attenuation factors (Hunter & Schmidt, 2004, p.124) and 95% confidence intervals were computed (Aguinis et al., 2011).

1.6 RESULTS

To test the DPCM model (De Dreu, Baas, et al., 2008), the results are reported following two contrasts, activating emotions compared to neutral and deactivating emotions. In each contrast, realising sub-group analysis, we tested the effect either all activating emotions, only activating positive emotions, or only activating negative emotions. Structural equation modelling in Mplus 8 (Muthén & Muthén, 2017) allowed us to conduct the necessary analyses. In each case, the results explained more than 60% of the variance of creativity (see tables 4 & 6). The models in tables 3 and 5 show that compared to neural and deactivating emotions, activating emotions trigger creativity through cognitive flexibility and cognitive persistence. However, concerning the comparison with deactivating emotions, there is a negative direct effect complementary to the positive indirect effect from emotions to creativity. A possible explanation is that emotions with higher level of energy trigger cognitive activation, beneficial for creative performance, but also distractibility (De Dreu, Baas, et al., 2008). Then, there is a need to consider not only the degree of activation of emotions but also their valence.

On one hand, considering only activating positive emotions, their effect on creativity through cognitive flexibility compared to neutral emotions and deactivating emotions is positive, in line with hypothesis 2b. Even though the direct effect is negative, which can be due to increased distractibility (De Dreu, Baas, et al., 2008), the total effect remains positive, in line with hypothesis 1a. A small but positive and significant indirect effect through cognitive persistence is also present, which might be due to the increase in motivation and task engagement (De Dreu, Baas, et al., 2008). On the other hand, considering only activating negative emotions, their effect on creativity is negative compared to neutral emotions. Moreover, their indirect effect on creativity from cognitive flexibility is negative, in line with the DPCM (De Dreu, Baas, et al., 2008), while their indirect effect through cognitive persistence is non-significative. However, compared to deactivating emotions, the effect of activating negative emotions on creativity is positive, in line with hypothesis 2a, their indirect effect through cognitive flexibility is also negative, while their indirect effect through cognitive persistence is positive, in line with hypothesis 2b. Then, the above analysis confirms hypotheses 1a and 1b while they partially confirm hypotheses 2a and 2b. Results are discussed in the next section below.

(Two-tailed p-value - *** $p \leq 0.001$, ** $p \leq 0.01$, * $p \leq 0.05$)

	k	N	r	Estimate	CI Lower limit	CI Upper limit
Persistence -> Creativity	29	4112	0.42	0.33***	0.31	0.35
Flexibility -> Creativity	43	5595	0.74	0.70***	0.68	0.72
Activating emotions						
Emotions -> Creativity	110	13679	0.13	0.07***	0.05	0.09
Emotions -> Persistence	12	1610	0.03	0.03*	0.00	0.07
Indirect effect (Persistence)				0.01*	0.00	0.02
Emotions -> Flexibility	56	5008	0.07	0.07***	0.03	0.10
Indirect effect (Flexibility)				0.05***	0.02	0.07
Activating Positive emotions						
Emotions -> Creativity	86	10094	0.31	0.13***	0.11	0.16
Emotions -> Persistence	7	1121	0.07	0.07***	0.04	0.11
Indirect effect (Persistence)				0.02***	0.01	0.04
Emotions -> Flexibility	37	3477	0.23	0.23***	0.20	0.27
Indirect effect (Flexibility)				0.16***	0.13	0.18
Activating Negative emotions						
Emotions -> Creativity	45	7629	-0.13	-0.05***	-0.07	-0.03
Emotions -> Persistence	9	1485	-0.00	-0.00	-0.4	0.03
Indirect effect (Persistence)				-0.00	-0.01	0.01
Emotions -> Flexibility	25	2919	-0.11	-0.11***	-0.15	-0.08
Indirect effect (Flexibility)				-0.078***	-0.10	-0.05

Table 3. Meta-analysis of the Emotion-Creativity relationship for the Activating-Neutral contrast

(Two-tailed p-value - *** $p \leq 0.001$, ** $p \leq 0.01$, * $p \leq 0.05$)

	Activating emotions	Activating positive emotions	Activating negative emotions
R ² Creativity	0.65***	0.663***	0.64***
R ² Persistence	0.001	0.005	0.000
R ² Flexibility	0.004	0.054***	0.013**

Table 4. R² for the Activating-Neutral contrast

(Two-tailed p-value - *** $p \leq 0.001$, ** $p \leq 0.01$, * $p \leq 0.05$)

	k	N	r	Estimate	CI Lower limit	CI Upper limit
Persistence -> Creativity	29	4112	0.42	0.34***	0.31	0.37
Flexibility -> Creativity	43	5595	0.74	0.72***	0.69	0.75
Activating emotions						
Emotions -> Creativity	43	3632	0.22	-0.05**	-0.08	-0.02
Emotions -> Persistence	4	378	0.12	0.12***	0.06	0.17
Indirect effect (Persistence)				0.04***	0.02	0.06
Emotions -> Flexibility	19	1513	0.32	0.32***	0.27	0.37
Indirect effect (Flexibility)				0.23***	0.19	0.27
Activating Positive emotions						
Emotions -> Creativity	41	3464	0.24	-0.05**	-0.08	-0.01
Emotions -> Persistence	3	294	0.13	0.13***	0.07	0.19
Indirect effect (Persistence)				0.05***	0.02	0.07
Emotions -> Flexibility	15	1013	0.34	0.34***	0.28	0.39
Indirect effect (Flexibility)				0.24***	0.20	0.28
Activating Negative emotions						
Emotions -> Creativity	4	327	0.29	0.2***	0.15	0.26
Emotions -> Persistence	3	270	0.13	0.13**	0.04	0.22
Indirect effect (Persistence)				0.02**	0.01	0.04
Emotions -> Flexibility	3	172	-0.14	-0.14**	-0.23	-0.05
Indirect effect (Flexibility)				-0.1**	-0.17	-0.03

Table 5. Meta-analysis of the Emotion-Creativity relationship for the Activating-Deactivating contrast

(Two-tailed p-value - *** $p \leq 0.001$, ** $p \leq 0.01$, * $p \leq 0.05$)

	Activating emotions	Activating positive emotions	Activating negative emotions
R ² Creativity	0.65***	0.65***	0.61***
R ² Persistence	0.01*	0.02*	0.02
R ² Flexibility	0.10***	0.11***	0.02

Table 6. R² for the Activating-Deactivating contrast

I.7 DISCUSSION

Our results are in line with the prior meta-analysis (Baas et al., 2008) as we reveal that compared to deactivating emotions and neutral states, activating emotions triggers better creative performance. Moreover, considering not only the level of energy of emotions but also their valence, we show that activating positive emotions trigger creative performance through cognitive flexibility. Compared to neutral emotions and deactivating emotions, our results suggest that, in line with the hypotheses, activating positive emotions enhance creative performance by considering different perspectives and broadening the scope of conceptual attention of individuals (De Dreu, Baas, et al., 2008). Activating positive emotions trigger cognitive persistence as well, but the effect size is smaller as such emotions trigger task engagement and enthusiasm, they can trigger cognitive persistence as well (Baas, 2019). Surprisingly, even though the total effect of activating positive emotions on creative performance is positive, when controlling for indirect effects through cognitive flexibility and persistence, the direct effect becomes negative. Such effect might be explained by the fact that, contrary to negative emotions, activating positive emotions can increase distractibility (De Dreu, Baas, et al., 2008): even though such emotions increase the breadth of attention, they can in parallel decrease the focus of individuals, which explain the presence of a negative component.

In line with the hypotheses, activating negative emotions enhance creative performance through cognitive persistence. However, this effect is present only when compared with deactivating emotions, not with neutral emotions. These emotions trigger task engagement and in-depth exploration only when compared with deactivating emotions: such results suggest that individuals with neutral emotions can narrow their focus and process information in detail for a creative task as much as individuals with activating negative emotions. On a less surprising note, in coherence with prior literature, whether this research compared activating negative

emotions with neutral or deactivating emotions, results suggest that these emotions remain detrimental to cognitive flexibility (Baas, 2019). In other words, activating negative emotions seem to impair the capacity to switch between different approaches in a creative task.

These findings are consistent with the findings of two prior meta-analyses (Baas et al., 2008; Davis, 2009), such as activating emotions triggering more creative performance than deactivating or neutral emotions. These findings explain the positive-negative emotions contrast as well: as mentioned above, Baas et al. (2008) showed there were no significant differences of effect between positive and negative emotions, while Davis (2009) showed that only on timed and ideation tasks, positive emotions produce more creativity than negative emotions. Results from this research explain these two findings: activating positive and negative emotions are beneficial to creative performance, in line with Baas et al. (2008), but through different mechanisms, cognitive flexibility, and cognitive persistence respectively. For instance; cognitive persistence represents a more prolonged effort by spending more time on the task. Then, the difference during timed and ideation tasks found by Davis (2009) means that for equal time, or in other words, for equal cognitive persistence, positive emotions will trigger more creativity than negative emotions. This notion supports our findings which suggest that, through the flexibility pathway, activating positive emotions triggers more creative performance than activating negative emotions. Accordingly, our results clarify the understanding of the emotion-creativity relationship, by establishing a scientific consensus about the involved mechanisms, cognitive flexibility and cognitive persistence, and the moderating role of valence and activation.

Finally, our research provides relevant managerial implications for the workplace. Individuals often have various and conflicting opinions concerning the type of emotion being the best for creativity (Baas et al., 2015), some think that they need to be relaxed or cheerful, while others believe that anger or fearful event will lead them to their creative peak (Baas,

2019). As our research shows that experiencing activating emotions would lead to higher creativity, either through a flexible or persistent approach, it resolves the conflicted thoughts in the practical world.

I.8 LIMITATIONS AND FUTURE STUDIES

Limitations of the results would be the methodology of the different studies involved, as it would be worth exploring if different methodological factors are moderating these effects. Such moderators would serve as how the emotions were measured (e.g., primed, self-reported, observed), the types of creativity measures (e.g., fluency, originality divergent thinking, convergent thinking, composite score), the study design (e.g., experimental, correlational), the study context (e.g., laboratory, field), the nature of the population (e.g., adult, managers, students, children), and the induction procedure (e.g., imagery techniques, emotion-inducing materials, emotional treatment, combination).

Future research could also explore how the regulatory focus moderates the two pathways of the DPCM (De Dreu, Baas, et al., 2008; Higgins, 2000). The regulatory focus theory proposes two perspectives: promotion-focused or prevention-focused emotion (Higgins, 2000). When experiencing promotion-focused emotions, the individual seeks the desired end-state, such as realizing a task associated with a reward upon completion, while experiencing prevention-focused emotions, the end-state is undesired, such as the non-realization of a task associated with punishment (To & Fisher, 2019). Future research could explore how emotions associated with a promotion focus facilitate creative performance and insight, and reinforce the effects of positive or negative activating emotions through cognitive flexibility and cognitive persistence, respectively (Baas et al., 2008).

Furthermore, future research would need to explore the emotion-creativity relationship in a more dynamic context. Even though prior research has demonstrated how isolated episodes of positive and negative emotions impact employees' creativity (Baas et al., 2008; Davis, 2009),

such static perspective is limited to understand the phenomena of emotional dynamics in the workplace. Despite nascent works (Bledow et al., 2013; Gong & Zhang, 2017; Szafert & Croes, 2018), examining interactive and dynamic effects of positive and negative emotions requires further research. For instance, as emotions “naturally” change with time, future studies could investigate how durations and intensity of emotional episodes impact employees’ creative performance, what sequences of emotions would lead to creativity, or how individuals can be self-aware of their emotions and enhance their creativity. Similarly, future studies could explore these questions regarding cognitive flexibility and cognitive persistence, as individuals might approach a creative problem differently over time. What optimum sequence between flexible and persistent approaches would lead to creativity? What would contextual elements from the workplace make individuals switch between these two different processings? Can individuals be self-aware of their cognitive approach and switch as the situation requires it?

I.9 CONCLUSION

To conclude, this research tests the DPCM with a meta-analytical approach and establishes a scientific consensus about the mechanisms involved in the emotion-creativity relationship. This work shows how two different and complementary cognitive approaches, flexibility and persistence, explain the effect of emotion on creativity and resolve prior inconsistencies in the literature. This research highlights the importance of emotion as a predictor of creativity and clarifies the mechanism as well as the type of emotions are leading to creativity.

CHAPTER II: THE EFFECT OF LEADERS'S EXPRESSIONS OF EMOTIONS ON INDIVIDUALS' CREATIVE PERFORMANCE

II.1 ABSTRACT:

Leaders frequently assign creative tasks to their individuals. Leaders' emotional expressions is well-known to be a powerful source of influence. Yet, the effect of the emotions expressed by the leaders on individuals' creativity has been poorly investigated. Using the EASI theory, this article examines how leaders' emotional expressions influence individuals' creative performance in terms of novelty, utility, variety and quantity of ideas. More specifically, this study compares the effect of expressions of ambivalence, happiness and anger. Two online and laboratory experiments show that idea variety and idea quantity increase when individuals receive creativity instructions from an angry leader than from a happy leader (study 1; N=146) decrease when they receive instructions from an ambivalent leader than from a happy leader (Study 2; N=194). In contrast, individuals generate more novel ideas with a happy leader than with an angry leader. This research contributes to the prior literature of creativity, by providing a clear comparison of the effect of emotional expressions in creativity instructions. This research also extends EASI theory, through the exploration of the effect of a mixed emotion, ambivalence. Finally, this article contributes to the literature in leadership, by focusing on leaders' emotional expressions at a specific dimension of leadership styles. This research provides practical implications about the emotional strategies and competences leaders should build at the workplace.

Keywords: Creativity, Emotions, Leadership, EASI theory, Idea Generation

II.2 INTRODUCTION

To create innovative products, leaders usually need to spend effort to motivate followers toward an objective and to enhance their creative performance (Shalley & Gilson, 2004; Shin & Zhou, 2003). In their attempts, leaders frequently use their own leadership styles as a powerful mean of influence (Huang et al., 2016; Hughes et al., 2018). In many popular accounts of successful innovations, famous leaders frequently show different leadership styles to boost the performance of the individuals. For instance, Steve Jobs expressed negative leadership style to enhance the innovative performance of collaborators, with often a challenging to endure and intimidating way to communicate: “My job is not to be easy on people. My job is to make them better [...] I want to see what people are like under pressure. I want to see if they just fold or if they have firm conviction” (Jobs & Beahm, 2011). Elon Musk incited them to try new ideas, providing support and psychological safety in the proposition of innovative trials: “Failure is an option here. If things are not failing, you are not innovating enough” (Reingold, 2005). In the accounts of historic leaders, leadership styles, whatever they are positive or negative, trigger the motivation of individuals, enhance their creative performance and in fine, the creation of innovative products.

However, even though leadership is recognized as a key predictor of individuals’ creativity (Shalley & Gilson, 2004), recent research has shown that it remains unclear which leadership styles are the most effective. Literature reviews showed that leaderships styles have similar effects on creativity (Hughes et al., 2018) and that researchers should study leadership style dimensions separately (van Knippenberg & Sitkin, 2013; van Knippenberg & van Kleef, 2016). In sum, scholars need to move away “from broad leadership ‘styles’ to consider more nuanced behaviour, which will increase our understanding of the basic building blocks of leader influence” (Hughes et al., 2018, p. 564). Therefore, this article focuses on leaders’ emotional

expressions, which represent such ‘nuanced behaviour’ that is an essential component of leadership styles (Van Kleef, 2009; van Knippenberg & van Kleef, 2016).

But which emotion(s) a leader should express to increase his or her individuals’ creativity? Past research showed that both negative and positive leaders’ emotions can trigger individuals’ creativity. Visser et al (2013) found that leaders’ expression of happiness better triggers individuals’ creativity, while Miron-Spektor et al.(2011) and Van Kleef et al. (2010) showed that, under particular circumstances, expression of anger better trigger individuals’ creativity. It remains inconclusive which emotion leaders should display to enhance individuals’ creativity because of several reasons. First, the emotions beneficial to individuals’ creativity have not been rigorously compared in same experiments. Second, prior studies were conducted in different experimental contexts (e.g. task instructions, idea feedbacks, etc...) which make the comparison difficult and hardly relevant since the effect of expression of emotion is context-dependant (Van Kleef, 2016). Such differences of contexts affect how leader’s expression of emotions is perceived and it impacts individuals’ behaviour (van Knippenberg & van Kleef, 2016). Third, even though studies have showed the importance of ambivalence for leaders (Methot et al., 2017; Rothman et al., 2017; Rothman & Melwani, 2017), a mixed emotion being the simultaneous feeling of positive and negative emotions, scholars put aside this emotional expression in creativity.

Therefore, this article answers the call of Hughes et al. (2018) who ask for more empirical evidences about the effect of emotions on creative leadership. Our research provides a direct and rigorous comparison between leader’s expression of anger, happiness and ambivalence and their effects on individuals’ creative performance. Our research identifies which emotion(s) a leader should express to enhance the creative performance of his or her individuals. Fulfilling this objective is essential because as Van Kleef, (2016) detailed: “effective leadership requires flexible and knowledgeable use of emotional strategies to ensure

that any emotional displays on the part of a leader have maximal positive and minimal negative impact on followers” (p.190). For now, leaders do not have sufficient scientific knowledge to elaborate upon such emotional strategies. This research is based on two experiments in which a leader recorded on video asks participants to generate creative ideas. The task instructions are identical in the different experimental conditions, what only changes is the emotional tone of the leader’s voice and face. The consensual assessment technique (Amabile, 1996; Runco & Jaeger, 2012) was used to measure the degree of novelty, usefulness, fluency (i.e., idea quantity) and flexibility (i.e., idea variety) of ideas generated by each participant. A first online experiment shows that expression of happiness and neutral emotions are more beneficial to individuals’ idea novelty than anger. A happy leader triggers more novel ideas from participants, but triggers a reduced number of ideas (i.e., fluency) and a reduced variety of ideas (i.e., flexibility). There is no significant difference in terms of utility. Then, a second laboratory experiment compares happiness and ambivalence, and shows that a happy leader conduces more ideas (i.e., better fluency and flexibility) than an ambivalent leader. There is no significant difference of novelty or usefulness of ideas between an ambivalent and a happy leader. In summary, our findings show that if the leader wants to provoke novel ideas from individuals, he should express happiness or ambivalence. In contrast, if the leader wants more ideas and more of a variety of ideas, he should express anger.

Thus, the results provide several theoretical insights. First, this article provides a complementary perspective on current theories of creativity (Amabile, 1988, p. 19; Amabile & Pratt, 2016; Harvey, 2014; Paulus & Dzindolet, 2008; Woodman et al., 1993) by focusing on an essential component of creative interactions, emotional expressions. Second, this research extends the EASI theory (Van Kleef, 2009), by extending the small number of studies dealing with a leader’s expression of emotion and individuals’ creativity (Miron-Spektor E et al., 2011; Van Kleef, Anastasopoulou, et al., 2010; Visser et al., 2013), and by including the effect of

expression of ambivalence, such emotional expression triggering idea novelty as well as expression of happiness. Finally, this article contributes to the literature on leadership, with the adoption of a more nuanced perspective on the behaviour of the leader and the exploration the effect of leader's expression of emotions, a factor put aside by prior literature (Hughes et al., 2018). Results also provide practical implications for leaders. First, they clarify which emotion they should express to make their individuals more creative in idea generation. Second, these results also highlight the importance for managers to develop their competences related to emotions, to be aware of the emotions they express to individuals and to understand their contextual effect. Finally, these studies not only tell managers which emotional expressions to use to enhance creative performance at work, but also provide results generalizable to an online situation. Leaders may need to express instructions through a video medium more frequently, due the appearance of the global pandemic and the development of remote working in the years to come.

II.3 LITERATURE REVIEW AND HYPOTHESES

II.3.1 Leaders and individuals' creativity

Creativity in the workplace is essential for maintaining competitive advantage and enhancing the growth and success of organizations (Shalley & Gilson, 2004). To survive in dynamic environments, organizations need to deal with unforeseen challenges and develop creative capabilities (Zhou & Hoever, 2014). To innovate, organizations need to obtain original and useful ideas from their individuals (N. Anderson et al., 2014; Hughes et al., 2018). Current theories of creativity on creativity focused on the individual, team, and organizational level with their contextual variables (Amabile, 1988; Amabile & Pratt, 2016; Woodman et al., 1993), or explored in more details the group level, with group, task, and situational variables (Paulus & Dzindolet, 2008) and the collective creative process (Harvey, 2014). A more recent current

examined at the dyad-level the different elements composing creative interactions, such as the words used in feedbacks for instance (Harrison & Rouse, 2015).

Among the different interactions beneficial to individuals' creativity in the workplace, scholars have shown that interactions with leaders are crucial (A. Lee et al., 2020; Mainemelis et al., 2015). Leaders facilitate individuals' creativity through their leadership styles (Hughes et al., 2018). To enhance individuals' creativity, leaders can adopt a transformational style with intellectual stimulation and inspirational motivation (Elkins & Keller, 2003), a transactional style with extrinsic motivations such as rewards or punishments (Byron & Khazanchi, 2012; Rank et al., 2009), or a leader-member exchange approach with relationship quality between the leader and the follower (Liao et al., 2010). To trigger creativity, leaders can also use more recent positive leadership styles such as empowering, servant or authentic approaches, or more negative leadership styles, such as despotic or authoritarian approaches (Hughes et al., 2018).

However, these leadership styles have been criticized for their lack of conceptual clarity (Hughes et al., 2018). Because of the proliferation of the variety of leadership approaches and the redundancy of the associated constructs (Shaffer et al., 2016), these different 'styles' have been found to share equivalent associations with individuals' creativity. Such similarity adds to the complexity of the literature and hinders our understanding of the effect of leadership on individuals' creativity. To clarify our understanding of such effects, research made a call to move from these broad approaches to a more focused investigations of the distinctive elements of leadership (Hughes et al., 2018). Leaders' expression of emotions represents an essential component of leader's influence on individuals' behaviour and performance (van Knippenberg & van Kleef, 2016). It is only recently that research has attempted to explore the interpersonal role of emotions within creative interactions, and has studied how leaders' emotional expressions may influence their individuals and their performance (Van Kleef, 2009).

II.3.2 Leaders' emotional expressions and individuals' creativity

Emotions are intense short-lived experiences directed to a certain stimulus (e.g., a concern, a goal, an event, a person) (Elfenbein, 2007; Frijda, 1988). This research aims to better understand the effect of leader's expression of emotions on individuals' creative performance. The EASI theory (Van Kleef, 2009; Van Kleef et al., 2011) states that expressions of emotions are a strong source of social influence: emotions not only have an effect on those who experience them, but they also shape the performance of those who observe them. This theory holds that the emotional expressions of one person (e.g., the leader) could affect the creative performance of the observers (e.g., the individuals). Two mediators explain such effect. On one hand, emotional expression can trigger *emotional contagion*, the observers mimicking and synchronizing their emotional states to the emotional expressions they have been exposed to. The emotion experienced by the observer will then influence their creative performance. For instance, face to a leader who expresses happiness, individuals feel the leader's happiness through emotional contagion (Barsade, 2002). The positive emotion experienced by individuals may trigger their creativity (De Dreu, Baas, et al., 2008). Similarly, the anger expressed by the leader may also be experienced by the individuals through emotional contagion. This felt negative emotion will enhance effortful and analytical information processing (Forgas, 2000; Schwarz, 1991; Sy et al., 2005) but not his or her creativity (Visser et al., 2013). Then, considering the first mediator, i.e. emotional contagion, leader's expression of happiness should better trigger individuals' creativity than their leader's expression of anger.

On the other hand, the EASI theory states that leader's emotional expressions can also influence individuals' creative performance through a second mediator: *inferential processes*. In that case, emotions expressed by the leader represent signals from which individuals glean information, via a deliberate and cognitively effortful process (Van Kleef, 2009). Then, such analysis of information will make individuals able to draw inferences about the situation, which

will influence his performance (Van Kleef et al., 2011). For instance, expression of happiness could signal that expectations toward the goal are positive and that the environment is favourable (Van Kleef, 2016). Individuals would understand they can take risks with a happy leader, and may propose ideas that are unfamiliar and original. More generally, such emotional expression provokes more pro-social behaviour from individuals (George & Bettenhausen, 1990; Sy et al., 2005): they consider the leader as more charismatic, perform better on the task at hand (Gaddis et al., 2004; Johnson, 2009) and then become more creative (Grant & Berry, 2011).

Similarly, leaders expressing anger send a signal to their individuals: individuals receiving a feedback with anger can infer that their leader is not satisfied of their creative performance, that they need to correct their behaviour and improve their creative process engagement so that they can meet the expectations (Miron-Spektor et al., 2011; Stets & Turner, 2006; Van Kleef et al., 2010). However, in the context of task instruction, leaders' expressions' of anger suggest a different signal to the individual: in that case, expressions of anger is synonymous of frustration and goal blockage (Van Kleef, 2016). Such a signal right before the beginning of the task would not be beneficial for individuals' creative performance and may be detrimental. Then, considering the second mediator, i.e. inferential processes, leaders' expression of happiness during task instructions should better trigger individuals' creativity than leaders' expression of anger.

Therefore, it is expected that during creative task instructions, leader's expression of happiness will trigger a better creative performance from individuals than leader's expression of anger.

H1: When leaders ask to generate new ideas, happy leaders will trigger a better creative performance than an angry leader.

Besides, even though prior studies focused on the effect of leader's expression of single discrete emotions (such as happiness and anger) on creative performance, in a similar vein, literature on ambivalence emphasizes the importance of expression of mixed emotions, i.e. of both positive and negative emotions at the same time (Fong, 2006). This second stream of literature provides empirical evidence that the expression of mixed emotions might trigger individuals' engagement and creativity. For instance, Stollberger & Guillaume (2016) showed that leaders expressing a mixed emotion during a feedback trigger more engagement and more creative performance in individuals than leaders expressing happiness or anger.

The two mediation paths proposed by EASI theory (Van Kleef, 2009) provide explanations why ambivalent leader enhance individuals' creativity. First, due to emotional contagion, individuals observing a leader expressing ambivalence will thus feel more ambivalence. Previous research shows that ambivalence make individuals more creative than happiness, since feeling ambivalent makes them more sensitive to unusual associations (Fong, 2006). Experiencing emotions of opposite valences vehiculates a sense of conflict, which allows individuals to integrate seemingly opposite elements into new concepts and solutions (Fong, 2006). Therefore, considering the first mediator, i.e. emotional contagion, ambivalent leaders should better trigger individuals' creative performance than happy leaders.

Second, concerning the mediator of inferential processes, such expression of emotion conveys information that can elicit commitment and flexibility from observers (Van Kleef, 2009). On one hand, individuals who observe leaders expressing mixed emotions can make inferences about the situation. Expressing ambivalence may signal that leaders face a complex situation, which requires deliberation and reflection (Rothman & Melwani, 2017; Rothman & Wiesenfeld, 2007). Individuals may perceive ambivalent leaders as looking for assistance, and the individuals may be less reluctant to suggest alternative ideas and perspectives (Rothman & Northcraft, 2015). In their theorizing about the social functions of mixed emotions, Rothman et

al. (2017) argued that leaders expressing ambivalence signal that they are trying to consider their complex environment in a nuanced way and to be cognitively flexible. Previous theorizing argued that group members expressing ambivalence increase the cognitive complexity of the group, by introducing uncertainty and doubt, reducing group conformity and by signalling that the problem at hand deserves more deliberation. Such signal motivates the group to engage into information search (Rothman & Wiesenfeld, 2007). Previous research also showed that compared to happiness and anger, individuals observing others expressing ambivalence will perceive them as more submissive, empowering the individuals to be more assertive (Rothman & Northcraft, 2015) and more proactive (Rothman & Melwani, 2017).

However, on the other hand, individuals who observe leaders expressing mixed emotions can make inferences about the personality of the leader as well. Even if individuals can see a leader expressing ambivalence as a character facing a complex situation (Rothman & Melwani, 2017), they can also perceive the leader as a less decisive person (Rothman & Wiesenfeld, 2007). Such a leader would appear confused and hesitant. Individuals can this also infer that such ambivalent leaders is not certain, or even incompetent (Rothman & Wiesenfeld, 2007). Such perception built on leader's emotional signals will then reduce individuals' engagement and creativity. Thus, considering the second mediator, i.e. inferential processes, it is not clear if an ambivalent leader should better trigger individuals' creative performance than a happy leader or not. Such uncertainty leads to the following hypotheses:

H2a: Happy leaders will trigger better creative performance from individuals than ambivalent leaders.

H2b: Ambivalent leaders will trigger better creative performance from individuals than happy leaders.

II.4 EXPERIMENT 1: METHOD AND DATA COLLECTION

II.4.1 Participants and experimental design

One hundred-fifty workers participated in return of 0.59 £, however 9 participants didn't propose any ideas or proposed ideas that were considered as unintelligible by the raters so they were removed. Therefore, 146 participants were included (M age = 36,95 years; SD age = 13,43; Men = 57; Female = 87; Other = 2). The design involved a manipulation of non-verbal emotional expression (anger vs neutral vs happy). Several indices of creativity served as dependant variables.

II.4.2 Overview of procedure

Participants took part of the study on Prolific academic, a UK website widely used by researchers allowing workers to participate in surveys and studies for academic research, supported by Oxford University, and rewarding them for taking part. The study was named "creativity and new products concepts" and participants read the description "In this study you will be asked to engage in a creative task and provide ideas about new product concepts". Using prolific filters, the sample was pre-selected with several criteria. In order to avoid any potential problems due to cultural diversity, the participants must have been born in UK, having one of the UK nationalities, and having spent most of their time before turning 18 in UK. The approval rate from other studies they were part of should be at least of 95%, ensuring that they execute the task seriously. Finally, since the creative task required them to find new product concepts in the domain sport and fitness, participants should at least do 60 minutes of weekly physical exercise.

At the beginning of the study, participants answer questions about demographics (gender, age) and about their mood. Since this project aims to better understand the effect of displaying specific emotions on individual creativity, it is crucial to control for the mood of the individual before applying the condition. So, a question about their overall mood was asked at

the beginning, among demographics questions. Then, participants were introduced to the task and told that they would need to come up with as many solutions as possible to a problem. Participants listened to the instructions from a leader who displayed a happy, neutral or angry expression, as detailed below. Finally, participants completed a post-experimental questionnaire, were thanked and dismissed.

II.4.3 Assessment of positive and negative moods

To control for the mood that participants had before doing the experiment, they had to answer to the BMIS (Brief Mood Introspection Scale) to measure how pleasant their mood is (Mayer & Gaschke, 1988). They had to rate from 1 (Definitely do not feel) to 4 (Definitely feel) sixteen adjectives, all responses to the question “Does the adjective describe your mood?”. The overall scores of positive and negative moods were represented as the average of the scores of the positive adjectives (lively, happy, caring content, peppy, calm, loving, active, $\alpha_{\text{positive}} = 0,802$) and the score of the negative ones (sad, tired, gloomy, jittery, drowsy, grouchy, nervous, fed up, $\alpha_{\text{negative}} = 0,874$) respectively.

II.4.4 Idea Generation task

Participants were introduced to the task with the following text: “We need you to aid a manager of a company to generate new product concepts. Innovate&Impact is a manufacturer working with Fortune 500 companies. One of Innovate&Impact's managers, Carl Smith, is working on an important project and is looking for as many ideas as he can get. Carl is going to brief you via video on what your task involves during the session. (Please make sure that your volume is turned up and that you can listen to the instructions).”

Then, the participants would look at a video of an American 32-year-old male researcher playing the manager Carl Smith. He asked them to execute the following task (Girotra et al., 2010), common to every condition of the experiment and with the standard brainstorming instructions (Osborn, 1953): “Hello, the aim of this project is to identify new sport and fitness

product concepts for the college market. Our company Innovate&Impact needs as many ideas as we can get. We are asking you to propose new sport and fitness product ideas for unmet needs or improved product ideas for existing needs. Generate as many ideas as you can, and do not criticize them. The more ideas the better, and the more unusual the idea the better. Also, do not hesitate in combining your ideas.” Participants had then 5 minutes to work on the task.

To assess that this text was in deed emotionally neutral, so that the manipulation of the emotions was only realised on the non-verbal behaviour of the person in the video, the emotional score was calculated in terms of positive, negative and ambivalent emotions (Harrison & Dossinger, 2017; Pennebaker et al., 2007) using LIWC (Linguistic Inquiry and Word Count). This text analysis application looks for keywords within each entry that match those in the application’s dictionary and registers the frequency of keywords matching a particular linguistic characteristic (ex: positive or negative emotion). The application then gave a value representing the percentage of that characteristic found in the entry. LIWC has been validated as method to analyse text communication (Pennebaker et al., 2007). The score of positive and negative emotions were low, respectively 3.53% and 2.35%. To check on ambivalence, following Harrison & Dossinger (2017), the equation of Thompson, Zanna, & Griffin (1995) $A = [(C + D)/2] - (D - C)$ was used. A represents the ambivalence score, D the dominant and C the conflicting response from the text entry. In that case, based on the scores, positive emotion is the dominant and negative emotion the conflicting response. The first part of the formula represents the average of positive and negative emotion in the text (the more intense the opposing emotions, the greater the ambivalence) while the second part is a correction for dissimilarity between the two emotions (the more similar in magnitude the opposing reactions are, the greater the ambivalence). In that case, the score of ambivalence was also low (1.76%).

Moreover, participants went through an attention check placed before the post-experimental questionnaire to ensure that the participants did listen the video. The question was

“In the video, Carl asked you to generate ideas about ... (1) New phone-and-accessories-product concepts for the college market, (2) New sport-and-fitness-product concepts for the college market (3) New dorm-and-apartment-product concepts for the college market, (4) New food-and-cooking-product concepts for the college market.” In case a technical problem occurred preventing participants to watch the video, they could see the video twice again. The analysis of the results excluded people who failed to pass the attention check twice.

II.4.6 Creative performance

To measure creative performance, we measured the fluency, the novelty, the utility and the flexibility of the participants (Guilford, 1967; Sternberg & Lubart, 1999). To assess them, two raters evaluated the ideas in terms of quantity (fluency, flexibility) and quality (novelty, utility) of ideas (Vosburg, 1998). *Fluency* represents the number of unique ideas proposed by the participants, and *flexibility*, the number of distinct semantic categories accessed by the participant (the more the categories, the more the flexibility). *Novelty* was defined as the extent to which the idea was novel compared to the products/services proposed in the sport industry, and *utility* as the extent to which the idea answers to an important user problem. Two raters coded the uniqueness of the idea with a numerical code (0 or 1), and Cohen’s Kappa coefficient showed a very good inter-agreement between the raters ($K = .8923$). Then, concerning the flexibility the unique ideas were content coded by one rater, who assigned them to a category. Then a second rater used the categories created by the first rater to code the unique ideas. The inter-rater agreement (ICC) was equal to 91.7%, which is excellent (Koo & Li, 2016). Finally, both raters assigned a score of novelty and utility to each unique idea (1 - not novel/useful at all; 7 – very novel/useful). The ICC of novelty was equal to 80.1 %, and the ICC of utility equal to 81.8%, which is very good (Koo & Li, 2016).

II.5 EXPERIMENT 1: RESULTS

The following will detail the results for each dimension of creative performance, this dependant variable being a multi-construct. Each dimension represents a measurement of the quantity of ideas (i.e. fluency, flexibility) or the quality of ideas (i.e. novelty, utility) (Vosburg, 1998). To summarize the findings before detailing each dimension, results suggest that an angry leader will trigger the quantity of ideas (i.e. fluency and flexibility), while a happy leader will trigger the quality of ideas (i.e. novelty of ideas). Details of each pairwise comparison are summarized in table 7. To test the effect of the expression of emotions on creative performance (hypothesis 1), a One-Way ANOVA was realised, with positive and negative moods of the participants controlled in the analysis. Since there was no effect of positive or negative moods of participants on fluency, on flexibility, on novelty and on utility, the variables were excluded from the analysis.

First, concerning the *fluency*, i.e. the number of ideas, results showed a significant effect of the expression of emotions on fluency ($F(2, 143) = 4.965$; $p=.008 < .05$). Looking at the pairwise comparisons, the happiness condition ($M = 4.84$; $SD = 0.541$; $N=45$) was significantly lower (mean difference = 1,514; $p = .041$) than the neutral condition ($M = 6.36$; $SD = .498$; $N=53$), which was not significantly lower ($p=.253$) than the anger condition ($M = 7.19$; $SD = .524$; $N = 48$). However, the happiness condition was significantly lower than the anger condition (mean difference = 2.34; $p= .002$).

Second, concerning the *flexibility*, results showed a significant effect of the expression of emotions on flexibility ($F(2, 143) = 4.483$; $p=.013 < .05$). Looking at the pairwise comparisons, the happiness condition ($M = 2.44$; $SD = .225$; $N=45$) was significantly lower (mean difference = .876; $p = .005$) than the neutral condition ($M = 3.32$; $SD = .207$; $N=53$), which was not significantly higher ($p= .3$) than the anger condition ($M = 3.14$; $SD = .217$; $N =$

48). The happiness condition was also significantly lower than the anger condition (mean difference = .701; $p = .026$).

Concerning the *novelty* of ideas, the variable was excluded and results showed a marginal effect of the expression of emotions on novelty ($F(2, 143) = 2.945$; $p = .056$). Looking at the pairwise comparisons, the happiness condition ($M = 3.54$; $SD = .16$; $N = 45$) was not significantly higher ($p = .344$) than the neutral condition ($M = 3.33$; $SD = .15$; $N = 53$), which was not significantly higher ($p = .128$) than the anger condition ($M = 3.01$; $SD = .15$; $N = 48$). However, the happiness condition was significantly higher than the anger condition (Mean difference = .528; $p = .018$).

Finally, concerning the *utility* of ideas, results showed no effect of the expression of emotions on utility ($F(2, 143) = 0.274$; $p = .761$). Looking at the pairwise comparisons, the happiness condition ($M = 4.44$; $SD = .17$; $N = 45$) was not significantly higher ($p = .746$) than the neutral condition ($M = 4.36$; $SD = .16$; $N = 53$), which was not significantly higher ($p = .663$) than the anger condition ($M = 4.26$; $SD = .17$; $N = 48$). Moreover, the happiness condition was not significantly higher than the anger condition ($p = .463$).

	F	p	Happy leader (N=45)		Neutral leader (N=53)		Angry leader (N=48)	
			M	SD	M	SD	M	SD
Fluency	4.965	.008	4.84	2.71	6.35	3.15	7.19	4.71
Flexibility	4.483	.013	2.44	1.12	3.32	1.71	3.15	1.58
Novelty	2.945	.056	3.54	1.05	3.33	1.07	3.01	1.06
Utility	0.274	.761	4.44	1.27	4.36	1.00	4.26	1.21

Table 7. Results experiment 1

Results also show that emotional contagion did not have any significant effect for any indices of creativity and did not mediate the effect the effect of expressions of emotions on creative performance.

This first experiment showed that, among the three single emotions, happiness and neutral emotion are the most beneficial emotions to express for enhancing the novelty of ideas of individuals. The next study will then aim at comparing happiness and ambivalence.

II.6 EXPERIMENT 2: METHOD AND DATA COLLECTION

II.6.1 Participants and experimental design

Two hundred students participated although 6 students were removed who either proposed no ideas or ones that were considered unintelligible by the raters. One hundred-ninety-four students remained (M age = 20.13 years; SD age = .775; Men = 85; Female, 107; Other = 2). The design involved a manipulation of non-verbal emotional expression, ie ambivalence (N=96) vs happy (N=98).

II.6.2 Overview of procedure

Participants took part in the study in a laboratory at a French Business School, and the steps of the questionnaires were similar to study 1. The task was identical, except that in this case, participants listened to the leader explaining instructions in a happy or ambivalent way, as detailed below.

II.6.3 Assessment of positive and negative moods and emotional contagion

To control for the mood participants had before doing the experiment, the BMIS (Brief Mood Introspection Scale) was used again to measure how pleasant the mood of participants was before starting. The overall scores of positive and negative moods were represented as the average of the scores of the positive adjectives (lively, happy, caring, content, peppy, calm, loving, active, $\alpha_{\text{positive}} = 0,751$) and the scores of the negative ones (sad, tired, gloomy, drowsy, grouchy, nervous, fed up, $\alpha_{\text{negative}} = 0,700$) respectively. Moreover, to control for emotional contagion, (Sinaceur et al., 2013; Visser et al., 2013), participant affect was measured using four items for happiness ($\alpha_{\text{participant happiness}} = 0,883$) and ambivalent ($\alpha_{\text{participant ambivalence}} = 0,859$): “In the last five minutes, I felt ...” and “The leader made me feel happy/glad/torn/conflicted”.

II.4.5 Manipulation of anger and happiness expression

The video clip of the manager has been recorded inside Grenoble Ecole de Management. Depending on the experimental condition (see Annexe A), the actor expressed anger, no emotion, or happiness, using facial expressions and vocal intonation. For example, in the anger condition, he frowned, looked stern and spoke with an angry and irritable tone of voice. In the happiness condition, he smiled a lot and spoke with a joyful and enthusiastic tone of voice (Barsade, 2002; Van Kleef, 2009; Van Kleef, Anastasopoulou, et al., 2010).

Before the experiment, a pre-test was given to test that the emotion was well-recognized by the participants. Following Sinaceur et al (2013), participants were asked in each condition “in general, how much did the manager express happiness / anger” and “at the end of the video, how much did the manager express happiness / anger” using a 7-point scale ($\alpha_{\text{happiness}} = .949$; $\alpha_{\text{anger}} = .927$). Independent sample t-tests revealed that participants in the happiness condition ($N = 60$, $M = 5.72$, $SD = 1.03$) rated the manager as happier ($t(118) = 11.8$, $p < .000$) than those in the neutral condition ($N = 60$, $M = 2.55$, $SD = 1.79$) and as happier ($t(124) = 11.984$, $p < .000$) than those in the anger condition ($N = 66$, $M = 2.44$, $SD = 1.86$). Similarly, participants in the anger condition ($N = 66$, $M = 3.93$, $SD = 1.92$) rated the manager as angrier ($t(124) = 6.166$, $p < .000$) than those in the neutral condition ($N = 60$, $M = 2.03$, $SD = 1.50$) and as angrier ($t(124) = 7.678$, $p < .000$) than those in the happiness condition ($N = 60$, $M = 1.66$, $SD = 1.31$).

A manipulation check was also realised in the main study. Using the same scale than the one used in the pre-test ($\alpha_{\text{happiness}} = .955$; $\alpha_{\text{anger}} = .943$), participants in the happy condition ($N = 45$, $M = 4.47$, $SD = 1.34$) rated the manager as happier, ($t(96) = 7.995$, $p < .000$) than those in the neutral condition ($N = 53$, $M = 2.31$, $SD = 1.32$) and as happier ($t(91) = 7.291$, $p < .000$) than those in the anger condition ($N = 48$, $M = 2.31$, $SD = 1.50$). Participants in the angry condition ($N = 48$, $M = 3.18$; $SD = 1.76$) rated the manager as angrier ($t(99) = 5.570$, $p < .000$) than those in the neutral condition ($N = 53$, $M = 1.60$, $SD = 1.01$) and as angrier ($t(91) = 4.279$,

$p < .000$) than those in the happy condition ($N = 45$, $M = 1.80$, $SD = 1.29$). Then, these results show the manipulation of the emotional expressions was executed well.

II.6.4 Idea Generation task

The task was pre-introduced to the participants with the same text than the one in study 1, the difference being that the text was written in French, and that the leader was called Cédric Martin. Then, the participants would look at a video of a 45-year-old male French researcher playing the manager Cédric Martin. The task instructions were identical to the ones in study 1, but in French.

To assess that this text was in deed emotionally neutral, so that the manipulation of the emotions was only realised on the non-verbal behaviour of the person in the video, the LIWC (Linguistic Inquiry and Word Count) score was calculated again in terms of positive, negative and ambivalent emotions (Harrison & Dossinger, 2017; Pennebaker et al., 2007) with the French text this time. The score of positive, negative and ambivalent emotions were both equal to 0%. The attention check was identical to the one in study 1. The analysis of the results excluded people who failed to pass the attention check.

II.6.5 Manipulation of ambivalence and happiness expression

The video clip of the manager was recorded in a French Business School. Depending on the experimental condition (see Annexe B), the researcher expressed ambivalence or happiness, using facial expressions and vocal intonation. For example, in the ambivalence condition, the actor in the videotape moved between inner brow raising and lowering, and his gaze shifted among having eye contact with the camera, looking downward, and looking off into space. He then showed the internal conflict he experienced by feeling ambivalent, i.e. feeling emotions from different valence at the same time (Rothman, 2011). In the happy condition, he smiled a lot and spoke with a joyful and enthusiastic tone of voice (Barsade, 2002; Van Kleef, 2009; Van Kleef, Anastasopoulou, et al., 2010).

A manipulation check was also realised in the main study. Following Sinaceur, Adam, Van Kleef, & Galinsky (2013), participants were asked in each condition “to what extent the person in the video was feeling the following emotions” “Happiness / Glad / Torn / Conflicted / using a 7-point scale ($\alpha_{\text{happiness}} = .917$; $\alpha_{\text{ambivalence}} = .802$). Independent sample t-tests revealed that participants in the happy condition (N = 98, M = 5.4, SD = 1.35) rated the manager as happier, $t(192) = -8.722$, $p < .001$) than those in the ambivalent condition (N = 96, M = 3.64, SD = 1.46). Similarly, participants in the ambivalent condition (N = 96, M = 2.59, SD = 1.41) rated the manager as more ambivalent, $t(192) = 4.480$, $p < .001$) than those in the happy condition (N = 98, M = 1.78, SD = 1.11). Then, these results show the manipulation of the emotion expression was executed well.

II.6.6 Creative performance

To measure creative performance, we measured the same dimensions used in study 1. Two raters coded the uniqueness of the idea with a numerical code (0 or 1), and Cohen’s Kappa coefficient showed a very good inter-agreement between the raters ($K = .9845$) for *fluency*. The disagreements were resolved after discussion. Then, concerning the *flexibility* the unique ideas were content coded by one rater, who assigned them to a category. Then a second rater used the categories created by the first rater to code the unique ideas. The inter-rater agreement (ICC) was equal to 94%, which is very good (Koo & Li, 2016). Finally, both raters assigned a score of *novelty* and *utility* to each unique idea (1 - not novel/useful at all; 7 – very novel/useful). The novelty ICC was equal to 92.3% which is very good and the utility ICC was equal to 79.6% which is good (Koo & Li, 2016).

II.7 EXPERIMENT 2: RESULTS

Similar to study 1, the following will detail the results for each dimension of creative performance, this dependant variable being a multi-construct. Each dimension represents a measurement of the quantity of ideas (i.e. fluency, flexibility) or the quality of ideas (i.e.

novelty, utility) (Vosburg, 1998). To summarize quickly the findings before going into details of each dimension, results suggest that a happy leader will trigger the quantity of ideas (i.e. fluency and flexibility) and there is no difference in the quality of the ideas (i.e. novelty and utility of ideas) between an ambivalent and an happy leader (details summarized in table 8). To test the effect of the expression of emotions on creative performance, a One-Way ANOVA was realised, the positive and negative moods of the participants being controlled in the analysis. Since these variables did not have any effect for fluency, novelty or utility, they were removed from the analysis. Concerning flexibility, negative mood had a significant effect and was kept in the model.

First, results showed a significant effect of the expression of emotions on *fluency* ($F(1, 192) = 80.643$; $p=.006 < .05$). The happiness condition ($M = 7.60$; $SD = 3.5$; $N=98$) was significantly higher than the ambivalent condition ($M = 6.31$; $SD =2.96$; $N=96$). Levene's test of equality of error variances was not significant ($F(1, 192) = 2.305$; $p=.131 > .05$). We then failed to reject the null hypothesis that the error variance of fluency is equal across groups.

Second, concerning the *flexibility*, i.e the number of categories, there was an effect of the negative mood of participants ($F(1, 191) = 12.592$; $p = .022$). Results showed a significant effect of the expression of emotions on flexibility ($F(1, 191) = 9.446$; $p = .047$). The happiness condition ($M = 3.61$; $SD = 1.74$; $N = 98$) was significantly than the ambivalent condition ($M = 3.08$; $SD =1.33$; $N = 96$). Levene's test of equality of error variances was significant ($F(1, 192) = 6.300$; $p = .013 < .05$). We then reject the null hypothesis that the error variance of flexibility is equal across groups.

Concerning the *novelty* of the ideas, results showed no significant effect of the expression of emotions on novelty ($F(1, 192) = 0.001$; $p = .971 > .05$). Levene's test of equality of error variances was not significant ($F(1, 192) = 3.182$; $p = .076 > .05$). We fail to reject the null hypothesis that the error variance of novelty is equal across groups.

Concerning the *utility* of the best ideas, results showed no significant effect of the expression of emotions on utility ($F(1, 192) = 1.672$; $p = .198 > .05$). Levene’s test of equality of error variances was not significant ($F(1, 192) = 1.886$; $p = .171 > .05$). We failed to reject the null hypothesis that the error variance of utility is equal across groups.

	F	p	Happy leader (N=98)		Ambivalent leader (N=96)	
			M	SD	M	SD
Fluency	80.643	.006	7.60	3.5	6.31	2.96
Flexibility	9.446	.047	3.61	1.74	3.08	1.33
Novelty	0.001	.971	2.58	1.25	2.58	1.09
Utility	1.672	.198	5.86	.67	5.72	.79

Table 8. Results experiment 2

As in Study 1, the variables related to emotional contagion did not have any significant effect for any indices of creativity and did not mediate the effect of emotional expressions on creative performance. Such results seem to suggest that, during creative task instructions, emotional expressions affect individual’s creativity thanks to their informational value they bring rather than the affective reactions they can provoke. The results will be discussed in the next section.

II.8 DISCUSSION AND THEORETICAL IMPLICATIONS

II.8.1 Theoretical implications

This research examines which emotion(s) a leader should express during task instructions to enhance individuals’ creative performance. Our findings show that if leaders want individuals to generate novel ideas, leaders should express happiness or ambivalence. Leaders should either smile or express their hesitation regarding the complexity of the task at hand. Moreover, happy leaders will obtain more ideas than ambivalent leaders.

This research brings several theoretical implications. First, this research provides a complementary perspective on the current theories of creativity. Woodman et al (1993) explored creativity intensively from a multi-level perspective while others focused specifically on the group level (Harvey, 2014; Paulus & Dzindolet, 2008), but none of them considered the

role of emotions in the creative process. Amabile & Pratt (2016) conceptualized emotions as individuals' internal feeling, not as an emotional expression towards individuals, and theorized how these internal feelings impact creativity at different stages, such as information search, idea generation or idea evaluation. Then, this research offers a complementary perspective to this model, by conceptualizing emotions as an emotional expression towards individuals and by exploring how they impact creativity at the idea generation phase. More specifically, this research shows that the emotion enhancing the most individuals' creative performance depends on the level of analysis. Research has greatly explored the emotion-creativity relationship (Baas et al., 2008; Davis, 2009) at the intrapersonal perspective, i.e. considering emotions felt by individuals only, and demonstrated that ambivalent individuals deliver a better creative performance than happy individuals (Fong, 2006). However, from an interpersonal perspective, i.e. considering emotions when leaders express them, results show that happy leaders enhance the most individuals' creative performance.

Second, this research contributes to the EASI theory (Van Kleef, 2009). Such theory is context-dependant (Van Kleef, 2016), and exploring in creative task instruction the effect of leaders' expression of ambivalence was "uncharted territory" (Van Kleef, 2016, p231). Contrary to Visser et al. (2013a), emotional contagion did not mediate our effect, showing that individuals' emotions of ambivalence did not impact individuals' creative performance, contrary to the intrapersonal perspective (Baas et al., 2008; Davis, 2009; Fong, 2006). Then, the inferential value of leaders' expression of ambivalence represents the mechanism explaining our effect. An ambivalent leader sends a signal that makes individuals less inclined to provide high idea quantity, even if they provide the same idea quality than with a happy leader. More specifically, the fact that expression of ambivalence sends a signal of submission (Rothman & Northcraft, 2015) might explain the difference in productivity of ideas. Even through expressing such signal might increase the engagement of the other part in context of negotiation or other

contexts of leadership (Rothman et al., 2017; Rothman & Melwani, 2017; Rothman & Northcraft, 2015), expression of ambivalence seems to decrease the engagement to provide ideas in high quantity.

Finally, this research contributes to the literature on leadership. Prior literature reviews showed that the definition of leadership styles was too broad, lacking of a clear multi-dimensional conceptualization, and not specifying precisely how each dimension has an influence on performance outcomes (van Knippenberg & Sitkin, 2013; van Knippenberg & van Kleef, 2016). In their review, Hughes et al (2018) also showed that different leadership styles can equivalent effects on creativity. Then, answering their call, this research focuses on an essential and narrower component of leadership style, leaders' emotional expressions, and clarifies their effect on individuals' creative performance.

II.8.2 Managerial implications

This research provides practical implications for leaders. First, this research states which emotion leaders should express to enhance the most individuals' creativity performance. Prior research has shown that emotional expressions from leaders can be an important source of influence, and yet, using emotional expressions to influence the performance of individuals is a delicate enterprise (Van Kleef & Côté, 2014). To build pertinent emotional strategies (Van Kleef, 2016), leaders need reliable knowledge about the effect of their emotional expressions. One could intuitively suggest that since task instruction would direct the attention and the focus of individuals on the task at hand and incite them to dedicate effort (Locke & Latham, 2013), the expression of anger would be the best fit to enhance performance. Such expression can trigger individuals' attention to details and effort (Van Kleef, 2016) more than expression of happiness or ambivalence, respectively signalling enthusiasm and hesitation. As a matter of fact, concerning creative performance, results suggest that leaders should express ambivalence or happiness to individuals for them to generate novel ideas.

Second, this research shows more generally the importance of developing managers' emotional intelligence. Specifically, they need to develop their awareness regarding the emotions they express towards individuals. Whether leaders are expressing emotions unconsciously or not, their emotional expressions have an effect on individuals' creative performance. Chosen poorly, these emotional expressions can be detrimental to the workplace's well-being and performance. Leaders need then to be able to self-control (Goleman et al., 2013; Goleman & Boyatzis, 2017), and choose the right emotional expression for the right workplace context. Therefore, their emotional expressions will not get in the way, on the contrary, they will help enhance individuals' creative performance.

Finally, as the experiments of this research used videos to transmit instructions to participants, these results are generalizable to the online context. Leaders work remotely more frequently due to the pandemic situation, they need to use video medium more to manage their newly remote individuals (Fosslien & Duffy, 2020; Gratton, 2021). However, leaders are often left clueless and inexperienced to face the unique challenges of remote working, raising the need to provide them knowledge and guidance (Larson et al., 2020). Therefore, this research is part of this approach and shows that leaders should express happiness or ambivalence in their zoom meetings to enhance individuals' creativity in a remote context.

II.8.3 Limitations and further research

It is important to discuss some limitations that come with the conclusions of these studies. First, to test the influence of a leader's expression on their individuals' creative performance, this article used laboratory and online experiments which could suffer from external validity issues. To increase the experimental realism, we implemented experimental vignette methodology with video vignettes (Aguinis & Bradley, 2014), which tends to increase the realism, to provide more external validity and to produce similar effects than those from field studies. Second, another limitation is the use of a male white actor. Prior research has

shown that leader's expression of emotions and its effect on performance can depend on leader's gender, ethnicity or age (Schaubroeck & Shao, 2012; Van Kleef, 2016; Van Kleef et al., 2012). Further research is required to generalize the findings and account for this.

Several future research directions are possible. First, since this research focused on the idea generation stage, next studies could investigate the effect of leaders' emotional expressions on individuals' creative process at different stages. The current research focuses on the emotions displayed during task instructions, it means before the individuals start their creative process. Further research may be conducted to understand how leaders' emotions influence individuals' creativity in later stages such as when leaders provide feedback to individuals' ideas (Amabile & Pratt, 2016). We should expect different results, because when individuals receive feedback about the work they have produced, their identity is more affected (Stets & Turner, 2006) than when they receive task instructions. Then, leaders' emotional expressions during feedback should trigger different emotional reactions and send different signals to individuals. There is then a need to determine which emotion should be used and what the relevant associated mechanisms are over the creative process.

Second, further research could examine how leaders can regulate their emotional expressions when they speak with their individuals and how authentic they are perceived. When they choose to express a specific emotion, leaders can focus on their feelings and adjust them to the emotional expression they are displaying: such operation is called "deep acting", as opposed to "surface acting", in which leaders do not intend to change and adapt their true feelings, they only hide them (Hochschild, 1979). The first has the advantage of making the emotional expression more authentic which could potentially impact the engagement of the individuals. In this article, the emotions were expressed by actors (see appendix A & B) who were able to adjust their internal feelings to the intended emotional expression. We can thus suppose that they practiced "deep acting". Future research could explore if, for the same

expressed emotion such as happiness or ambivalence, surface or deep acting makes a difference in individuals' creative performance. Such research would give even more knowledge and leverage for the emotional strategies that managers could build to enhance their individuals' creative performance.

Third, another extension of this research would be to compare the effect of emotional expressions through the lens of other dimensions of emotions. Research studying the effect of leaders' expressions on individuals performance mainly discussed the effect of valence, i.e. positive vs negative emotions (van Knippenberg & van Kleef, 2016). However, prior scholars examining the effect of experiencing emotions on creative performance have showed that the degree of activation, or the association with self-regulation, can moderate this effect (Baas et al., 2008). Further research could compare the effect of expression of activating emotions (happy, fear) vs deactivating ones (calm, depressed). Future studies could also compare the effect of expression of promotion-focus (happy, angry, sad) prevention-focus (calm, fear, disgust) emotions, which differ in terms of approach or avoidance behaviour regarding the task at hand. Such exploration would allow to better understand, with more nuance, how different emotional dimensions might moderate the effect of leaders' emotional expressions on their individuals' creative performance.

Finally, future research could compare the effect of leaders' emotional expressions with different types of creative performance. In this article, the problem at hand ("provide ideas about new product concepts") required individuals to use divergent thinking, i.e. to use their ability to make unusual associations and provide various solutions to one question (Isen & Daubman, 1984). However, other types of creativity, such as convergent thinking, require individuals to use their knowledge to analyse the available information and provide the best answer possible for a given problem (Cropley, 2006). From an intrapersonal perspective, i.e. considering emotions as a feeling experienced by individuals, research has already shown that

positive emotions such as happiness can broaden the ability to make unusual associations (De Dreu, Baas, et al., 2008; Isen & Daubman, 1984) and enhance divergent thinking, while negative emotions such as anger can lead to more detail-oriented information processing (Baas et al., 2008; De Dreu, Baas, et al., 2008) such as convergent thinking. Future studies could explore this comparison at the interpersonal level and analyse which emotions expressed by leaders optimize their individuals' convergent thinking.

II.9 CONCLUSION

To conclude, this research answers to the call of Hughes et al. (2018) to move from analysing the effect of broad leadership styles to a more nuanced perspective of the behaviour of leaders. This article looks in detail at one of the essential components of leadership, i.e. leader's expression of emotions (van Knippenberg & van Kleef, 2016). This study additionally has practical implications. Not only does this article provide reliable knowledge to build emotional strategies and enhance individuals' creative performance, but it also shows that managers need to be aware of which emotions they express for enhancing the creative performance of their individuals.

II.11 APPENDIX

II.11.1 Appendix A

Experiment 1: Facial expression of the manager



Happiness Condition



Anger Condition



Neutral Condition

II.11.2 Appendix B

Experiment 2: Facial expression of the manager



Happiness condition



Ambivalence condition

CHAPTER III: CROWD SCIENCE PROJECTS:

HOW LEADERS' EMOTIONS SHAPE ONLINE PARTICIPATION

III.1 ABSTRACT

To resolve complex scientific challenges, scientists increasingly collaborate with online communities. However, maintaining a high level of participation in crowd-science projects is difficult. This research aims to understand how leaders' expressions of emotions can enhance voluntary participation in crowd-science projects. This research is based on Polymath, a crowd-science project where professional and non-professional mathematicians collaborate to solve very difficult problems. Drawing on the EASI Theory, we explore the influence of leaders' emotions on subsequent participation with a multi-level count analysis. We find that (1) leaders' positive emotions have a positive relationship through participants' positive emotions with participation's quantity and quality, and (2) leaders' negative emotions have a negative relationship through participants' cognitive complexity. By examining the role of leaders' affective dimension in crowd-science projects, our research brings theoretical contributions to crowd science and online community leadership literatures. Our research also extends the EASI theory through the exploration of its mechanisms, through its application in text-based communication contexts and highlights the importance of emotional intensity. Limitations and future directions are discussed.

Keywords: Leadership; emotion; crowd science; participation

III.2 INTRODUCTION

To tackle complex scientific problems, a growing number of scientists collaborate with online communities of volunteers (Cooper et al., 2010; Franzoni & Sauermann, 2014; Nielsen, 2020; Raddick et al., 2013; Sauermann et al., 2020; Scheliga et al., 2016). Crowd science projects enable professional scientists to access a large pool of professional and non-professional scientists with diverse skills at a low cost (Franzoni et al., 2021). Such diversity of knowledge may increase the speed at which the most complex scientific problems can be solved (Jeppesen & Lakhani, 2010). One emblematic crowd science project is *Polymath* initiated by Prof. Timothy Gowers, a mathematician professor at the University of Cambridge (Gowers & Nielsen, 2009). On 27th January 2009, Timothy Gowers posted an unsolved mathematical problem in his blog and asked his readers to share their ideas and thoughts. Seven weeks later, 40 participants successfully solved the problem (Polymath, 2012a).

However, maintaining a high level of participation in crowd science projects remains difficult (Ali-Khan et al., 2017; Franzoni & Sauermann, 2014; Nov et al., 2011; Sauermann & Franzoni, 2015). The majority of participants in crowd science projects are typically not paid for their work (Lyons & Zhang, 2019; Scheliga et al., 2018). Many of these volunteers do not actively contribute but only follow discussions and provide sporadic contributions (Amichai-Hamburger et al., 2016; Sun et al., 2014). The participation in online communities seems to follow the famous “90-9-1” rule, which states that 90% of the participants only read messages, 9% of the participants edit a few messages and 1% of the participants actively create new content (Arthur, 2006). Sauermann and Franzoni's study (2015) analyze the rate of participation in seven crowd science projects of the Zooniverse platform. Again, their findings indicate that most of the participants do not actively contribute and that the turnover is very high. Few participants produce more than 70% of the total content while most of the other contribute only once and with little effort (Franzoni & Sauermann, 2014; Sauermann & Franzoni, 2015). In a

study of crowd science project at NASA, Nov et al. (2011) explain that volunteers' motivations may decrease over time because the projects' outputs are not immediate and because participants do not always receive recognitions for their own contribution.

To maintain voluntary participation in crowd science projects, the role of leaders has been underscored. Empirical studies point out that crowd science projects' leaders are usually the investigators who set-up the scientific objectives, organize the experiments, synthesize the latest results and coordinate the work to keep the projects on track (Franzoni et al., 2021; Franzoni & Sauermann, 2014; Sauermann & Franzoni, 2015). The crucial role of leaders has been also noted in other type of voluntary-based online projects such as open source software communities (Faraj et al., 2015; Li et al., 2012). Leaders in such online communities often provide remarkable technical contributions which inspire and motivate other participants (Fleming & Waguespack, 2007).

Most prior studies investigating how leaders support participation in online communities revolve around structural, social and technical issues (Ball, 2014; Franzoni & Sauermann, 2014; Sauermann & Franzoni, 2015), however, less is known about how much leaders' emotions could influence the participation of crowd science projects' members. Prior research show that leaders often use affective words in their communication with online communities (Huffaker, 2010; Johnson et al., 2015). Emotions often drive the engagement and involvement of members of online communities (Bateman et al., 2010; Garcia et al., 2016). Still, we know little about how the emotional tone of leaders' messages affect members' participation in crowd science project. In particular, we do not know whether leaders should express positive and/or negative emotions to enhance members' participation in crowd science projects. Prior research remain inconclusive. In a series of laboratory experiments, Venus et al. (2013) find that people are more likely to support and share the visions of leaders who communicate their messages with positive emotions. In contrast, other research emphasizes that

participants of online communities tend to react and reply more to leaders' negative messages (Chmiel et al., 2011; H.-H. M. Lee & van Dolen, 2015).

To frame our investigation, we leverage theorizing on the EASI theory about the interpersonal effects of emotions (Van Kleef, 2009). This theory holds that the emotional expressions of one person often influence other individuals through two mechanisms. Emotional expressions can lead to affective reactions in others through *emotional contagion*. For instance, a leader who expresses happiness often make their employees happier (Barsade, 2002). Emotional expressions can also be interpreted by others as meaningful information – a second mechanism known as *cognitive inferences*. For instance, when leaders express negative emotions, employees can interpret them as signals that the current situation is not convenient and requires adjustments (Van Kleef, Anastasopoulou, et al., 2010).

Building on EASI theory and leadership literature, this research hypothesizes that (1) leaders' positive emotions have a positive relationship through emotional contagion with participation's quantity and quality, while (2) leaders' negative emotions have a negative relationship through participants' cognitive inferences. We test these hypotheses through an analysis of four successful Polymath projects. Polymath is a relevant empirical setting for this research for several reasons. First, creating and maintaining a high level of participation in Polymath is challenging. In Polymath projects, the participation cannot be easily increased by decomposing problems into smaller ones (Franzoni & Sauermann, 2014; Giuri et al., 2010; Sauermann & Franzoni, 2015). The complexity and non-modularity of Polymath projects require a certain level of expertise in mathematics, which is a major obstacle for participation. Also, Polymath addresses problems that have never been solved, the chances of success are extremely low, which may easily discourage participants. Second, Polymath leaders play a critical role in supporting participation (Ball, 2014; Cranshaw & Kittur, 2011; Franzoni & Sauermann, 2014; Kloumann et al., 2016). Prior studies show that Polymath leaders extensively

communicate with participants (Franzoni et al., 2021). The presence of Polymath leaders is crucial to keep a global focus and head for the resolution of the problem at hand. Finally, solving complicated mathematical problems induces a large spectrum of emotions, from negative emotions of frustration to more positive emotions of “Aha” moments (McLeod, 1988; McLeod & Adams, 2012; Muis et al., 2015). We thus expect that the emotional tone of the leaders may have a significant influence on the participants’ motivation to contribute.

To investigate Polymath leaders’ emotions, the emotional content of the leaders’ posts is measured with the Linguistic Inquiry and Word Count (LIWC) text application (Pennebaker et al., 2015). Based on multilevel count analysis, the effect of leaders’ emotions on subsequent participation (i.e., number of participants per day and participation quality) is analysed. Our findings show that leaders’ positive emotions have a positive relationship through participants’ positive emotions with participation’s quantity and quality, while leaders’ negative emotions have a negative relationship through participants’ cognitive complexity.

This study has three main theoretical implications. First, this work has implications for research in organizational aspects of crowd-science, particularly on the motivational aspects of crowd participation (Franzoni et al., 2021). Our results show that leaders’ emotional expressions represent another important driver of crowd-science participation. Second, this study provides implications for research on the micro-foundations of open innovation in science (Beck et al., 2020). In particular, findings show that the affective dimension of leaders deserves consideration since it significantly influences participation. Third, our research extends our understanding of the contagion-interpretation model of EASI theory (Van Kleef, 2009; van Knippenberg & van Kleef, 2016) explores the medium of text-based communication contexts and emphasizes the importance of emotional intensity. Limitations and future directions are discussed.

III.3 LITERATURE REVIEW

III.3.1 Crowd science: volunteers' online participation

A growing amount of scientific research is done in an open manner (Sauermann and Franzoni, 2015). Crowd science appears as a form of open organizing where '*participation in a project is open to a wide base of potential contributors, intermediate inputs such as data or problem solving algorithms are made openly available*' (p.1) (Franzoni & Sauermann, 2014). For instance, Franzoni & Sauermann (2014) and Scheliga et al (2018) show that most of crowd science projects are compliant with open participation and open access features. There is often no formal restriction in terms of participation. In most of crowd science projects, the intermediate and final inputs are openly shared. The success of crowd science projects critically depends on the degree to which participants provide continuous inputs (Sauermann and Franzoni, 2015).

Extant literature demonstrates that participants often join a crowd science project because the topic itself is of interest to them (Brossard et al., 2005). In contrast to crowdsourcing, where monetary prizes are common, crowd science projects heavily depend on volunteers whom do not receive any pecuniary rewards (Friesike & Schildhauer, 2015). Raddick et al (2013) analyze participants' motivation in the crowd science project - Galaxy Zoo, an astronomy project that invites people to assist in the classification of large numbers of galaxies. While the authors note that crowds' motivation is multifaceted, the most common motivation was an intrinsic interest in the topic of astronomy. Brabham (2010) pointed out that some participants have a broader interest in just being part of a community. Prior work also assumes that participants increase their understanding about the process of science. Though, as Sauermann and Franzoni (2015) indicated, the authors often participate only once and their effort is limited. The issue of maintaining motivation online persists (Riesch & Potter, 2014). Additionally, the more complex and ill-structured is the task, the more contributors need to

interact and build on each other's inputs, limiting the number of contributors who can work on a given project at the same time (Franzoni & Sauermann, 2014).

Prior work on online communities and open science indicated the importance of leadership and coordination in managing online participation and maintaining the engagement levels (Faraj et al., 2015; Li et al., 2012). Leaders' role in supporting participation in online communities revolves around structural, social and technical issues (Franzoni & Sauermann, 2014; Kokshagina, 2019; Scheliga et al., 2016), however, less is known about how much leaders' emotions contribute to supporting online participation.

III.3.2 Theoretical background: EASI Theory

Human motivation and behaviour are influenced by primary drivers such as emotions, which influence social interactions (Van Kleef, 2009; van Knippenberg & van Kleef, 2016). Prior research has shown that leaders can use their emotional expressions as a powerful mean of influence to enhance the performance of followers to the best of their abilities (Van Kleef, 2016). For instance, prior studies demonstrated that leaders' expressions of emotions can trigger analytical performance, creative performance and creative task engagement of their followers (Van Kleef, Anastasopoulou, et al., 2010; Visser et al., 2013). Leaders' emotional expressions can also affect followers' perceptions of the leader, which would in turn influence their motivation to accomplish the task and their engagement to attain a particular goal.

The EASI theory (Van Kleef, 2009) provides theoretical arguments about how leaders' emotional expressions could enhance participation in crowd science project. The EASI theory aims at better predicting how emotions expressed by one person can have an influence on the behaviour of others. This theory has been applied to explain the social effects of emotions in several social activities such as group dynamics (Dezecache et al., 2013), conflict and negotiation (Sinaceur et al., 2013) or consumer behaviour (Cheshin et al., 2018). Recently, the domain of leadership has received some attention (Van Kleef, 2016). Following the EASI

theory (Van Kleef, 2009), the contagion-interpretation model predicts that leaders' emotional expressions influence followers through two paths: affective reactions (contagion) and/or cognitive inferences (interpretation) (Van Kleef, 2009; van Knippenberg & van Kleef, 2016). On one hand, participants may feel the emotions that leaders express, through *emotional contagion*, and such emotions can influence their behaviour. For instance, Visser et al. (2013a) show that leaders' expression of happiness increases the followers' feelings of happiness, which triggers their cognitive flexibility, and in turn, increase employees' creativity. Similarly, these authors showed that followers could also experience the sadness of leaders, which positively impact their analytical performance. On the other hand, leaders do not always influence followers' own emotions, in contrast, followers can consider leaders' emotions as information. For instance, leaders' emotions may be interpreted as a signal for a change: when leaders give feedback on followers' ideas with anger, the followers may interpret such negative emotional expression as a signal that their creative performance is not satisfactory and need to be improved (Van Kleef, Anastasopoulou, et al., 2010).

III.3.3 Hypotheses Development

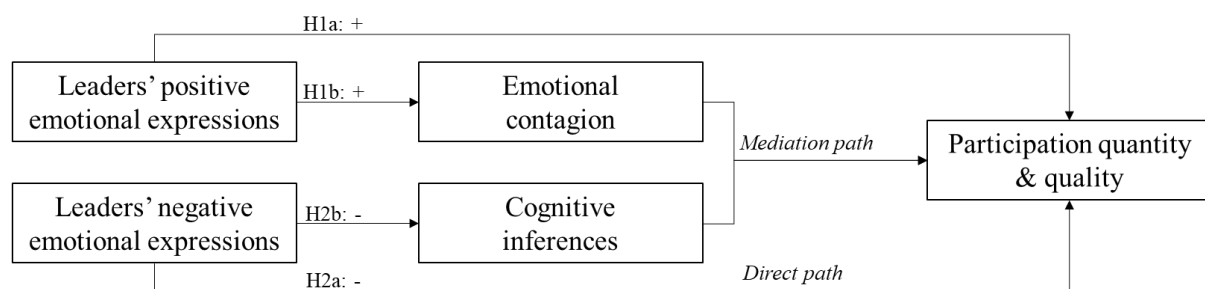


Figure 5. Conceptual model tested through text-mining data

Prior literature has already explored the effect of positive and negative emotions on team performance (Van Kleef, 2009, 2016). Findings show that these effects are very context dependant. Prior studies show that followers often appreciate and are motivated by leaders who display positive emotions (Johnson, 2009; Rubin et al., 2005). For instance, the overall quality of leader-member exchanges tends to increase with the rise of leaders' positive emotions (Day

& Crain, 1992). Also, leaders who express positive emotions are usually perceived as more charismatic (Awamleh & Gardner, 1999; Bono & Ilies, 2006; Damen et al., 2008). Moreover, prior research shows that transformational leaders tend to express positive emotions, which enhance goal commitment (Chi et al., 2011). Transformational leaders are found to be particularly good at inspiring others and motivating collaborative behaviours (Van Kleef, 2016). Transformational leaders allow for self-direction and for volunteers to challenge and stimulate each other's perspectives (Li et al., 2012). Volunteers will then be more motivated to adopt a pro-social behaviour, which will increase collaboration (George & Bettenhausen, 1990). Furthermore, leaders' positive emotional expressions enable volunteers to adopt better group coordination in their exchanges to resolve the problem at hand (Sy et al., 2005), which leads to better team performance (Chi et al., 2011; Gaddis et al., 2004; George, 1995). To summarize, prior research suggest that leaders who express positive emotions would be more likely to energize their followers. In the context of our research, we thus hypothesize (see figure 5):

Hypothesis 1a: Online participation in crowd science projects increases with the rise of leaders' expression of positive emotions.

When leaders express positive emotions, participants can experience positive affective reactions through emotional contagion (Van Kleef, 2016; van Knippenberg & van Kleef, 2016). Barsade (2002) showed that when people work together, their emotions tend to converge over time. Positive emotional expressions are also contagious even when people express emotions through text-based communication (Cheshin et al., 2011; Van Kleef et al., 2015). Participants can then experience the leaders' positive emotions, which broaden their thought-action repertoire, enhance their creativity (Baas et al., 2008; Visser et al., 2013) and allow for exploration (Fredrickson & Branigan, 2005). Furthermore, prior research shows that people who are confronted to leaders expressing positive emotions will tend to react positively and like the leader (Van Kleef, 2009). When leaders express positive emotions, participants tend to like

them more (Van Kleef et al., 2009), their relationship with the leaders is better (Day & Crain, 1992), and leaders are seen as more charismatic (Bono & Ilies, 2006). Therefore, leaders' expression of positive emotions make participants more engaged to create favourable outcomes (Staw et al., 1994)

Hypothesis 1b: The effect of leaders' expression of emotions on online participation is mediated by participants' emotional contagion.

In contrast, empirical evidence suggests that leaders' negative emotions, but expressed with low intensity only, can also be beneficial. Research shows that leaders' expressions of negative emotions may give signals of honesty and credibility to volunteers, as well as clues of trustworthiness (Bucy, 2000). For instance, leaders expressing negative emotions such as anger may appear as decisive and competent leaders (C. Anderson & Kilduff, 2009; Lord et al., 1986; Tiedens, 2001; Van Kleef, 2016). When they express negative emotions and behave assertively, leaders express dominance, are perceived as more competent and obtain higher levels of influence in groups (C. Anderson & Kilduff, 2009). Leaders' negative emotional expressions may then trigger volunteers' motivation to work on the problem at hand, and to provide more effort and persistence in the task (Sy et al., 2005). Also, leaders' feedback formulated with an angry tone are found to enhance individual creativity and team's analytical performance (Van Kleef, Anastasopoulou, et al., 2010; Van Kleef et al., 2009), since they signal to participants that they have to correct their behaviour to increase their performance.

However, expressing too much negative emotions can also be perceived as inappropriate by the followers (Van Kleef et al., 2012). When negative emotions are perceived as inappropriate, followers can become unwilling to perform organizational citizenship behaviour (Koning & Van Kleef, 2015). Moreover, in text-based communication such as in crowd science project, participants often perceive the intensity of negative emotions higher than it is in reality (negativity bias) (Parkinson, 2008), and negative emotions are more quickly judged as

inappropriate. The reason is that contrary to face-to-face interactions, text-based communication does not allow for non-verbal cues (face, tone of voice, gestures), which offers nuances of negative emotions (P. Ekman, 2009; P. Ekman et al., 1976; Parkinson, 2008). Text-based communication is quite restrictive and requires leaders to express negative emotions in a more explicit manner (Parkinson, 2008). Contrary to face-to-face interactions. In summary, according to prior studies, it may be expected that volunteers in crowd science projects should be more motivated to participate if leaders express moderately negative emotions. We thus hypothesize:

Hypothesis 2a: Online participation in crowd-science projects is higher with intermediate levels of leaders' expressing negative emotions (i.e., inverted U-shape relationship).

When leaders express too much negative emotional expressions, participants can cognitively infer such emotional expressions as a signal of inappropriateness, and as a result provide less effort (Van Kleef et al., 2012) In their recent review, Van Kleef & Côté (2021) showed that negative emotional intensity can have curvilinear effects on perceived appropriateness across diverse domains: excessive emotional intensity will be seen as inappropriate and then will be detrimental to outcomes. For instance, the Dual Threshold Model of anger (Geddes & Callister, 2007) suggests that there is a threshold of intensity of anger, after which excessive expressions of anger will be perceived as inappropriate by volunteers, and therefore reduce their willingness to cooperate. In cooperative settings such as a crowd-science project, such excess of leaders' negative emotional expressions can be inferred as inappropriate, which will reduce cooperativeness among participants and increase tendencies to move against the teammates (Van Kleef, De Dreu, et al., 2010). In other words, participants would reduce their effort in elaborating posts to solve the scientific problem at hand, i.e. reduce the cognitive complexity of their posts, and in the end, reduce the quality and quantity of participation.

Hypothesis 2b: The inverted U-shape effect of leaders' negative emotional expressions on online participation is mediated by participants' cognitive inferences.

III.4 METHOD

III.4.1 Sample

This research is based on the empirical analysis of Polymath, a crowd science project initiated by mathematicians, which aims at solving extremely difficult mathematics problems (Ball, 2014). Our sample includes 345 individuals involved in four successful Polymath projects (Polymath 1, Polymath 4, Polymath 5 and Polymath 8) (see Appendix A for more details). These projects were judged as successful and resulted in peer-reviewed publications (Castricky et al., 2014; Polymath, 2010, 2012a, 2012b, 2014; Tao, 2017). Polymath 1 aimed at finding a new combinatorial proof to the density version of the Hales–Jewett theorem. Polymath 4 was related to deterministic methods to find primes. Polymath 5 aimed at solving the Erdős discrepancy problem. Polymath 8 was about improving the bounds for small gaps between primes. These four projects lasted from 20 months to 70 months. They comprised between 600 and 2600 online posts and attracted between 44 and 110 participants (see appendix A).

To identify leaders in each Polymath project, we followed the definition of Cranshaw & Kittur, (2011), i.e., we considered their academic reputation and the number of posts published (see Appendices A & B). Besides, in their theory of leadership in self-managing virtual teams, Eseryel et al. (2021) showed that individuals perceived as online leaders are the ones who contribute the most to the task at hand. Based on the quantity of posts written, we identified then two leaders for each Polymath project, these leaders having contributed significantly more than the Top 3 contributor and the rest of the participants (see Appendix C). For instance, Terrence Tao and Timothy Gowers are two well-known mathematicians with a strong academic reputation, as they have won both a medal fields (e.g. the equivalent of the Noble Prize for mathematical disciplines).

III.4.2 Statistical Approach

Following Cranshaw & Kittur (2011), we structured the data per day so that we could explore the impact of emotional tone expressed by leaders during the previous active (i.e., day D-1), on other members' participation the next day (i.e., Day D). To explore this relationship, models in table 9 explore the link between the control variables, the emotional tone (i.e., positive or negative) from leaders and participants and online participation from volunteers.

III.4.3 Variables definition

III.4.3.1 Independent variable

This research uses the Linguistic Inquiry and Word Count (LIWC) text analysis application (Pennebaker et al., 2007) to investigate the emotional tone of the online messages exchanged by the leaders and the other participants. LIWC consists of dictionaries of over 2,300 words categorized by independent judges into 68 psychological and cognitive dimensions. We use then the following variables as independent variables: *Positive Leaders Day D-1* and *Negative Leaders Day D-1*, i.e., the average daily scores of positive and negative emotional tone respectively, for Day D-1 from the leaders.

III.4.3.2 Dependent variable

The variable to measure the quantity of participation, named *Participation Quantity*¹, is the number of participants on Day D, while the one to measure the quality of participation, named *Participation Quality*, is the average number of cognitive words (e.g., cause, know, ought) written on Day D by volunteers. Such words are recognized using LIWC and represent true markers of cognitive activity and processes (Pennebaker et al., 2015).

III.4.3.3 Mediators

This research considers also mediating variables, the first being *Emotional contagion Day D*, i.e., the score of positive emotional tone for Day D from the participants. The second

¹ Leaders were not counted in this variable, only the volunteers.

mediating variable is *Cognitive Inferences Day D*, measured through the cognitive complexity of participants' posts. Participants provide less cognitive effort and complexity in the problem at hand when they have cognitive inferences about the leaders. Cognitive complexity was measured as the average number of differentiation words (but, without, exclude) for Day D, since people using differentiation words tend to express complex thoughts, differentiate between multiple competing solutions, and are attempting to establish distinctions (Pennebaker et al., 2015; Tausczik & Pennebaker, 2010).

III.4.3.4 Control variables

To control for alternative explanations, we used *Positive Participants Day D-1* and *Negative Participants Day D-1*, i.e., the average daily scores of positive and negative emotional tone respectively, for Day D-1 from the volunteers. We also considered variables linked to the amount of participants' activity from the previous active day. Indeed, prior research shows that in open-science platform, comments from leaders and contributors spur activity on the next day (Cranshaw & Kittur, 2011). We considered then the number of posts on the previous active day *Number posts Leaders Day D-1* and *Number posts Participants Day D-1*, respectively from the leaders and the participants. Also, online participation might be influenced by participants anonymity (Spears et al., 2007; Spears & Lea, 1994). The variable *Number anonymous Day D-1* controls this aspect: a value of 1 is assigned when the participant is anonymous, 0 otherwise. Furthermore, the fact that day D may be a weekend day may explain a decline of participation. The dummy variable *Weekend* controls for such effect with 1 when day D is a weekend, and with 0 otherwise. Also, the variables *Timeline* and *Timeline²* control for the possibility that the participation increases at the beginning of the project and decreases naturally with time. Tables 9 & 10 report how the different variables were coded and provide descriptive statistics for the variables.

Nature of the variable	Name of the variable	Definition		Coding of the variable	
Dependent	<i>Participation Quantity</i>	Number of unique participants on Day D		Number of contributors who published at least one post on day D	
	<i>Participation Quality</i>	Score of cognitive words on Day D	from the participants		
Mediators	<i>Emotional contagion Day D</i>	Score of positive emotional tone on Day D	from the participants	Aggregation per active day (average) of the scores given by LIWC on each post	
	<i>Cognitive Inferences Day D</i>	Score of cognitive complexity on Day D			
Independent	<i>Positive Leaders Day D-1</i>	Score of positive emotional tone on Day D-1	from the leaders		
	<i>Negative Leaders Day D-1</i>	Score of negative emotional tone on Day D-1			
Control	<i>Positive Participants Day D-1</i>	Score of positive emotional tone on Day D-1	from the participants		
	<i>Negative Participants Day D-1</i>	Score of negative emotional tone on Day D-1			
	<i>Number posts Leaders Day D-1</i>	Number of posts on Day D-1	from the leaders		
	<i>Number posts Participants Day D-1</i>		from the participants		
	<i>Number Anonymous Day D-1</i>	Number of anonymous contributors on Day D-1			Aggregation per active day of the number of anonymous contributors
	<i>Weekend</i>	Score informing if Day D is a weekend or not.			Dummy variable: 1 if Day D is a weekend day, 0 otherwise.
	<i>Timeline</i>	Chronology of active days		Number of active days since the beginning of the project	

Table 9. Variables from text-mining data

Variable	Descriptive statistics				Correlation															
	Mean	S.D.	Min	Max	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.
1. Participation Quantity	2.27	2.14	0	12.00	1.00															
2. Participation Quality	14.07	6.77	0	36.36	0.34***	1.00														
3. Emotional contagion Day D	2.77	3.11	0	37.69	0.11**	0.23***	1.00													
4. Cognitive inferences Day D	3.49	2.38	0	14.29	0.30***	0.75***	0.09*	1.00												
5. Positive Leaders Day D-1	2.31	2.53	0	25.00	0.08*	0.03	0.08*	0.00	1.00											
6. Positive Participants Day D-1	2.77	3.11	0	37.69	0.04	0.06	0.13***	0.06	0.10**	1.00										
7. Negative Leaders Day D-1	0.90	1.24	0	12.50	0.11**	-0.01	0.04	0.00	0.19***	0.05	1.00									
8. Negative Leaders Day D-1 ²	2.34	8.95	0	156.25	-0.03	-0.01	0.05	-0.07	0.13***	0.03	0.83***	1.00								
9. Negative Participants Day D-1	1.09	1.63	0	25.00	0.04	0.00	-0.03	0.01	-0.06	-0.02	0.04	0.02	1.00							
10. Negative Participants Day D-1 ²	3.83	25.76	0	625.00	-0.05	-0.08*	-0.04	-0.05	-0.06	-0.05	-0.02	-0.00	0.81***	1.00						
11. Number Posts Leaders Day D-1	3.92	5.47	0	39.00	0.55***	0.13***	0.03	0.14***	0.17***	0.03	0.20***	-0.01	0.04	-0.05	1.00					
12. Number Posts Participants Day D-1	5.11	6.15	0	44.00	0.63***	0.17***	0.06	0.16***	0.09*	0.07	0.11**	-0.03	0.08*	-0.04	0.67***	1.00				
13. Number Anonymous Day D	0.86	1.64	0	19.00	0.35***	0.06	0.09*	0.06	0.07	0.11**	0.05	-0.00	0.04	-0.03	0.35***	0.56***	1.00			
14. Weekend	0.28	0.45	0	1.00	-0.05	-0.01	-0.02	0.02	0.02	-0.06	0.04	0.06	0.04	0.01	0.00	-0.02	-0.09*	1.00		
15. Timeline	382.5	220.7	1.0	764.00	-0.23***	-0.10**	0.16***	-0.08*	0.24***	0.16***	0.01	0.05	-0.04	0.05	-0.20***	-0.25***	0.01	0.02	1.00	
16. Timeline ²	114.8	80.31	1.0	301.0	-0.36***	-0.10**	-0.01	-0.08*	0.09*	-0.01	-0.06	-0.01	0.00	0.08*	-0.27***	-0.36***	-0.18***	-0.00	0.72***	1.0

Table 10. Descriptive statistics (* p < 0.05, ** p < 0.01, *** p < 0.001)

III.5 ESTIMATION & RESULTS

Because of the limited nature of the variable (it is a count variable) and the fact that we examined four different Polymath projects, a non-linear estimator was employed, i.e. multilevel count analysis. Since the data had a nested nature, we used multilevel structural equation modelling in Mplus 8 (Muthén & Muthén, 2017). The level corresponding to the Polymath projects explains 15% of the variance in the results that will follow. To check on a potential multicollinearity issue, we calculated the variance inflation factor (VIF) in each model and found a maximum of 2.16, and we checked from the correlation matrix that for every independent variable, each correlation factor with the dependant variables is strictly inferior to 0.7, demonstrating no issues on that side.

N=760 Two-tailed p-value - *** $p \leq 0.001$, ** $p \leq 0.01$, * $p \leq 0.05$

	Controls only: Model 1	Main effects Added: Model 2
	Estimate	Estimate
Participation Quantity		
Negative participants Day D-1	.069	.054
Negative participants Day D-1 ²	-.008*	-.006*
Positive participants Day D-1	.010	.000
Number posts Participants Day D-1	.043***	.038***
Number posts Leaders Day D-1	.025***	.020***
Anonymous Day D-1	-.008	-.007
Weekend	-.092**	-.106***
Timeline	-.022	-.034
Timeline ²	.000	.000
Participation Quality		
Negative participants Day D-1	.576***	.383***
Negative participants Day D-1 ²	-.046***	-.028***
Positive participants Day D-1	.087	-.031
Number posts Participants Day D-1	.171*	.062
Number posts Leaders Day D-1	.039*	.026
Anonymous Day D-1	-.157	-.112**
Weekend	-.199	-.526
Timeline	.282	.084
Timeline ²	-.011	-.004
Emotional contagion Day D		
Negative participants Day D-1	-.051	-.045
Negative participants Day D-1 ²	.000	.000
Positive participants Day D-1	.122***	.115***
Number posts Participants Day D-1	.015	.017
Number posts Leaders Day D-1	-.002	-.005
Anonymous Day D-1	.128*	.122*
Weekend	-.036	-.071
Timeline	.063	.065

	Timeline ²	-.002	-.002
Cognitive inferences Day D			
	Negative participants Day D-1	.125*	.123*
	Negative participants Day D-1 ²	-.010***	-.010***
	Positive participants Day D-1	.037	.039
	Number posts Participants Day D-1	.052**	.050**
	Number posts Leaders Day D-1	.028	.022
	Anonymous Day D-1	-.053	-.047
	Weekend	.129	.156
	Timeline	.089*	.085*
	Timeline ²	-.003*	-.003*
		Controls only: Model 1	Main effects Added: Model 2
			Estimate
Participation Quality			
	Emotional contagion Day D (H1b)		.027*
	Positive Leaders Day D-1 (H1a)		.020***
	Cognitive inferences Day D (H2b)		.102***
	Negative Leaders Day D-1 (H2a)		.070
	Negative Leaders Day D-1 ² (H2a)		-.010
Participation Quality			
	Emotional contagion Day D (H1b)		.330*
	Positive Leaders Day D-1 (H1a)		.078
	Cognitive inferences Day D (H2b)		2.082***
	Negative Leaders Day D-1 (H2a)		-1.128***
	Negative Leaders Day D-1 ² (H2a)		.151***
Emotional contagion Day D			
	Positive Leaders Day D-1 (H1b)		.080***
	Negative Leaders Day D-1		-.112
	Negative Leaders Day D-1 ²		.028**
Cognitive inferences Day D			
	Positive Leaders Day D-1		-.017
	Negative Leaders Day D-1 (H2b)		.185
	Negative Leaders Day D-1 ² (H2b)		-.038*

Table 11. Estimation and results

Results from Table 11 & 12 support H1a and H1b: leaders' positive emotions have a direct effect ($p < .001$) and a partial mediated effect ($p < .001$) on participation quantity, as well as a full mediated effect ($p < .01$) on participation quality, both through emotional contagion. These results then strongly suggest that leaders' positive emotions are contagious and influence participation, both in terms of quantity and quality of participations, through the emotions of volunteers.

Moreover, these results partially support H2a and H2b. Leaders' negative emotions have a full mediated effect ($p < .01$) on participation quantity, through participants' cognitive complexity. However, even if our p-value shows a significant inverted U-shape relationship within our data sample, more refined analysis shows that while leaders' negative emotions increase, our estimate goes from

significantly null ($p < .01$) to significantly negative ($p < .01$). Then, results show a full mediated decreasing effect on participation quantity, and strongly suggest that leaders' negative emotions decrease participation's quantity, not through participants' emotions this time, but through participants' cognitive complexity. Concerning participation quality, results show also a partially mediated decreasing effect, the estimate going from non-significant ($p > .05$) to significantly negative ($p < .000$) as leaders' negative emotions increase, similarly to participation quantity. However, contrary to our expectations, the direct effect (H2a) complementing our indirect is significant ($p < .001$) and U-shaped. As leaders' negative emotions increase, our estimate goes from being significantly negative ($p < .001$) to significantly positive ($p < .001$). In other words, not only leaders' negative emotions partially decrease participation quality through participants' cognitive complexity, they also increase participation quality at high levels of negative emotions. These results reveal that the effect of leaders' negative emotions is part of a much more complex phenomenon than hypothesized.

Hypothesis	Variable			Direct effect		Mediated effect	
	Independent	Mediator	Dependent	Estimate	p-value	Estimate	p-value
H1 (supported)	Positive Leaders Day D-1	Emotional contagion Day D	Participation Quantity	.020	.000***	.002	.000***
			Participation Quality	.078	.306	.026	.002**
H2 (partially supported)	Negative Leaders Day D-1	Cognitive Inferences Day D	Participation Quantity	-.010	.135	-.004	.006**
	(min)			-.001	.135	.000	.006**
	(max)			-.130	.135	-.049	.006**
	Negative Leaders Day D-1		Participation Quality	-.977	.000***	.306	.215
	(min)			-1.113	.000***	.378	.160
	(max)			.758	.000***	-.614	.000***

Table 12. Direct and indirect effects – mediation tests

III.6 DISCUSSION

Prior works on crowd science project emphasized the importance of leaders in coordinating and managing online participation and in maintaining engagement levels (Faraj et al., 2015; Li et al., 2012). Yet, prior work mainly focused on structural, social and technical issues that leaders deal with (Franzoni & Sauermann, 2014; Kokshagina, 2019; Scheliga et al., 2016). This research examines how leaders' emotions influence online participation in crowd science projects. By exploring the role of leaders on participants' behaviour in four Polymath projects, we show that leaders' positive emotions increase online participation's quantity and quality through participants' emotional contagion, while leaders' negative emotions decrease online participation's quantity and quality through participants' cognitive inferences.

II.6.1 Theoretical and practical implications

This study has two theoretical implications. First, this work provides theoretical implications for research on the organizational aspects of crowd-science (Franzoni & Sauermann, 2014; Sauermann & Franzoni, 2015). In their recent and integrative framework, Franzoni et al. (2021) propose that crowd-science volunteers mostly participate because they are intrinsically motivated by the topic, they are curious to learn more and they desire to contribute to scientific progress. Our results show that leaders' emotional expressions, external stimulus impacting emotional and cognitive internal mechanisms, may be another important driver of crowd-science participation. Future research should explore how leaders' emotions drive participation in another empirical setting than Polymath. Results might be different as Polymath represents an extreme crowd-science case, the majority of volunteers having contributed for a short period of time contrary to other crowd-science projects (Sauermann & Franzoni, 2015).

Second, this work provides broader implications for research on the micro-foundations of open innovation in science (Franzoni et al., 2021). Prior studies has focused on factors related

to leaders' behaviors such as sociability, knowledge contribution and use of network (Dong & Götz, 2020; Faraj et al., 2015; Fleming & Waguespack, 2007; Sutanto et al., 2011). Our research underscores the role of leaders' emotion in crowd science projects. Here, the results show that the emotional component of leaders' messages influences online participation and is a factor that deserves more attention. Our results particularly suggest that to be efficient, leaders should express positive emotions at high intensity. Then, we suggest that the emotions expressed by leaders in an online context are an important yet underestimated driver that deserves more attention and that can be used to influence online behaviour.

Third, this work extends the EASI theory (Van Kleef, 2009) by moving forward the contagion-interpretation model proposed by Van Knippenberg & Van Kleef (2016). We adopted a contingent perspective and showed that the mediation path of the leaders' emotions effect depends on the valence of said emotions: leaders' positive emotions tend to be contagious with participants' emotions, while leaders' negative emotions tend to be cognitively interpreted by participants. While prior empirical work have identified moderators such as participants' epistemic motivation or task criterion (Van Kleef, 2016; van Kleef & Côté, 2021; van Knippenberg & van Kleef, 2016), this research puts an emphasis on the valence of emotional expressions as another possible moderator, extending the boundary conditions of the EASI theory (Van Kleef, 2009).

Moreover, this works extends the EASI theory (Van Kleef, 2009) by focusing on the medium of text-based communication, since prior studies on leadership using this theory mainly focused on the expression of emotions in face-to-face interactions. People seem to perceive emotional expressions differently between an online and an offline setting, and such difference of perception seems to enhance different effects. For instance, in an online setting, people consider negative emotions as more negative than they truly are (*negativity bias*), and are unaware of this bias (Byron, 2008). On the contrary, people can fail to recognize positive

emotions and consider them as neutral (*neutrality bias*) (Byron, 2008). These biases could explain how leaders' negative emotional expressions only have a decreasing effect on online participation. Then, we suggest that the emotions expressed by leaders in an online context are an important, yet underestimated, driver that deserves more attention and that can be used to influence online behaviour.

Finally, this work extends the EASI theory (Van Kleef, 2009) by emphasizing the role of leaders' emotional intensity. Prior studies about leadership using this theory focused on the effect of the valence (positive vs negative) rather than on the intensity of emotional expressions and Van Kleef (2016) points out that "it is currently unknown exactly how intensity moderates the effects of emotional expressions" (p232). Rare studies approaching the effect of negative emotional intensity in negotiation (Adam & Brett, 2018) or in sports management (Staw et al, 2019) showed that such effect is strongly correlated with the perceived inappropriateness of an emotional expression. This resonates with the dual threshold model of anger (Geddes & Callister, 2007), in which leaders' negative emotions have a decreasing effect after a certain level of intensity, and explains partially our results. It is then possible that a leader's expression of negative emotions has an effect on participation not through emotional contagion, but through the perception of inappropriateness that participants make from leaders' negative emotional expressions, impacting participants' cognitive complexity as well. However, results also show that the effect of leaders' negative emotional expressions is multiple, and a part follows a U-shaped relationship. This shows that leaders' negative emotional expressions send signals that can be interpreted in multiple ways, and these different cognitive inferences can trigger competing effects. Future research should then examine the competing mechanisms of the effect of leaders' negative emotional expressions. Therefore, with the consideration of valence, text-based communication emotional intensity, we derive additional predictions of the EASI theory with greater specificity.

III.6.2 Limitations and future research directions

Our findings and contributions reflect limitations and boundary conditions. First, we have explored the role of leaders' emotions in a special case of crowd science projects – Polymath. We assume that observing other types of online organizations might demonstrate different results, especially in non-scientific contexts. We suggest, then, the following future research directions. First, future research should investigate how leaders' tones of emotions vary in different contexts of online, physical and blended environments. Second, future work can explore in detail how leaders can balance their emotions to ensure constant flux of participation and how emotions can appear as a parameter to consider when designing better online engagement. Third, the notion of leadership online deserves more focus. For example, future work can explore the role of clearly appointed and emerging leaders during online projects.

III.7 CONCLUSION

To conclude, this research analyses the effect of leaders' emotional expressions on participation's quantity and quality in crowd-science projects. Our research brings theoretical contributions to crowd science and online community leadership literatures, by showing that leaders' affective dimension is a driver of participation that deserves more attention. Our research also explores the mechanisms of the EASI theory (Van Kleef, 2009), its application in text-based communication contexts and the role of emotional intensity.

III.9 APPENDIX

III.9.1 Appendix A

Participation in the Polymath projects

Polymath #		1	4	5	8
Period		2009-2011	2009-2011	2009-2015	2013-2014
Number of participants		44	82	110	157
Number of posts	Total	1494	599	2637	2138
	Leaders	612 (40,96%)	203 (33,89%)	1311 (49,72%)	858 (40,13%)
	Leader 1	Tim Gowers (22,56%)	Terrence Tao (20,7%)	Tim Gowers (34,17%)	Eytan Paldi (21,38%)
	Leader 2	Terrence Tao (18,41%)	Ernie Croot (13,19%)	Alec Eglington (15,55%)	Terrence Tao (18,76%)
	Participants	882 (59,04%)	396 (66,11%)	1326 (50,28%)	1280 (59,87%)
	Participants Top 1	12,45%	8,18%	5,38%	10,48%
	Participants Top 2	7,9%	6,68%	5,27%	8,92%
	Participants Top 3	7,43%	5,01%	4,93%	5,99%
	Participants Top 4	5,89%	4,84%	4,66%	5,29%
Number of days		1006	2011	2135	608
Number of active days	Total	109	108	246	309
	Leader	72 (66,06%)	67 (62,04%)	183 (74,39%)	238 (77,02%)
	Participants	105 (96,33%)	83 (76,85%)	220 (89,43%)	270 (87,38%)

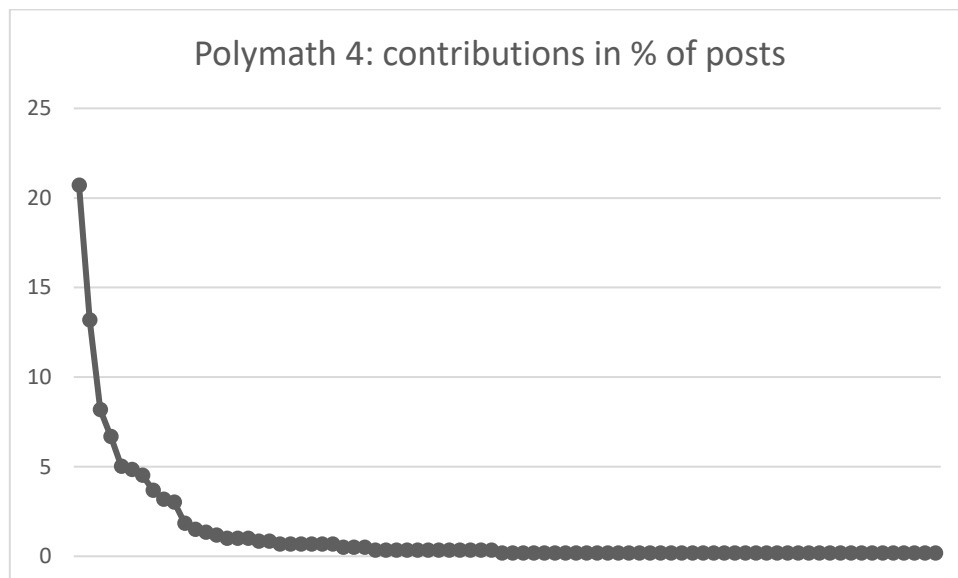
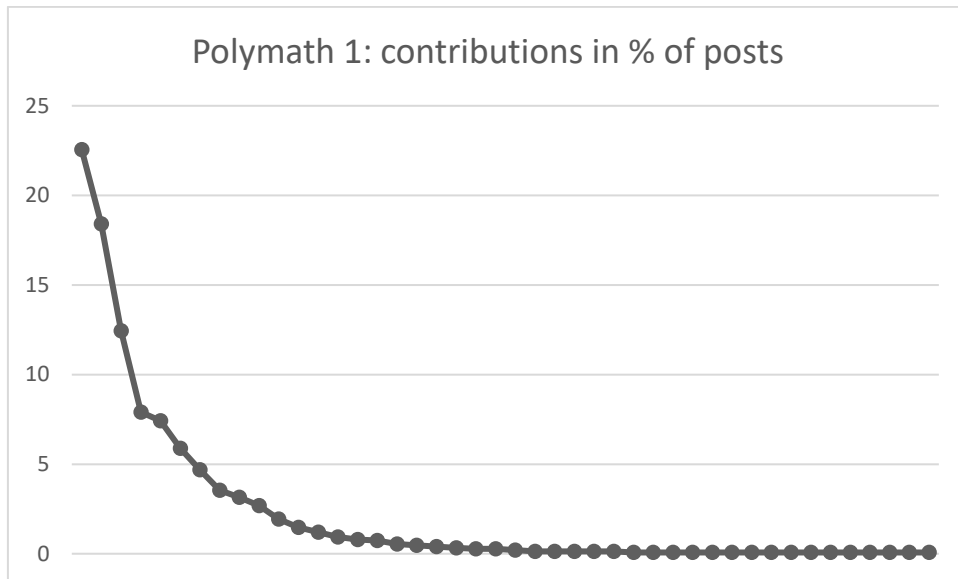
III.9.2 Appendix B

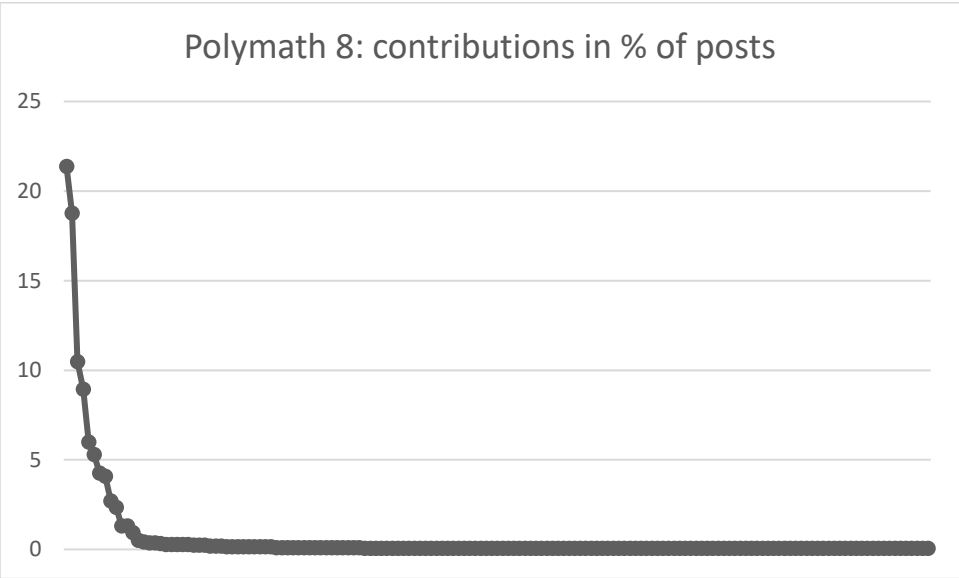
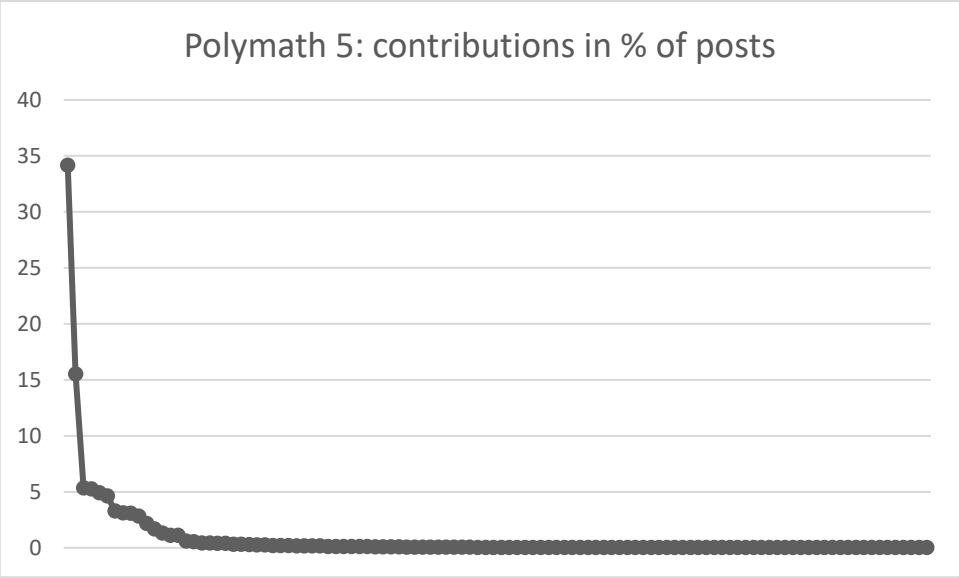
Leaders and affiliations

Leaders	Affiliation
Timothy Gowers	University of Cambridge
Terrence Tao	Université de Californie à Los Angeles
Eytan Paldi	Israel Institute of Technology
Ernie Croot	Georgia Institute of Technology
Alec Egdington	Cambridge Quantum Computing

III.9.3 Appendix C

Leaders' and participants' quantity of posts per Polymath project





GENERAL CONCLUSION

This research aims at better understanding the emotion-creativity relationship at the intrapersonal level and interpersonal level.

At the intrapersonal level, the first paper established a scientific consensus about the mechanisms of such relationship. Using the DPCM (De Dreu, Baas, et al., 2008), this research demonstrated using a meta-analytic approach that activating positive emotions lead to creativity through cognitive flexibility while activating negative emotions lead to creativity through cognitive persistence. Such research resolved the inconsistencies from prior meta-analyses (Baas et al., 2008; Davis, 2009) and clarified the mechanisms involved in this relationship. Limitations of this research would be the lack of consideration of methodological moderators, such as the way emotions were measured (primed, self-reported, observed), the types of creativity measures (fluency, originality divergent thinking, convergent thinking, composite score), the study design (experimental, correlational), the study context (laboratory, field) the nature of the population (adult, managers, students, children), and the induction procedure (imagery techniques, emotion-inducing materials, emotional treatment, combination). Moreover, as this research demonstrates the underlying mechanisms of the emotion-creativity relationship, future research could adopt a temporal perspective to explain this phenomenon. This study adopted a static perspective in which individuals were having short episodes of emotions, and yet, in organizational settings, individuals experience different emotions over time. A creative problem in organizations can take more than the time of a creative task in a laboratory setting: then it will be pertinent to move from a static to a dynamic perspective, and consider how different sequences of emotions over time would lead to cognitive flexibility, cognitive persistence and creativity. In that regard, future research could apply this dynamic perspective to understand the temporal effects of emotions on innovation and on the complementary processes, through longitudinal studies.

The second paper moves from an intrapersonal to an interpersonal perspective, and aims at better understanding the effect of leaders' emotional expressions on individuals' creativity. This research contributes to the literature of leadership and creativity by focusing on an essential component of leadership, emotional expressions (van Knippenberg & van Kleef, 2016), and by clarifying which emotion a leader should display to enhance individuals' creative performance. This research using laboratory experiments might suffer from external validity, even though experimental vignette methodology with video vignettes was implemented (Aguinis & Bradley, 2014), which tends to increase the realism, to provide more external validity and to produce similar effects than those from field studies. Future research could then aim to understand how leaders' emotional expressions influence individuals' creativity at different stages of creativity, from task instruction to feedbacks, as individuals will not be committed in the same way to their ideas and will produce different affective reactions (Stets & Turner, 2006; Van Kleef, 2009). Future research could also compare how leaders' emotional expressions influence individuals' different types of creative performance, from divergent thinking to convergent thinking tasks. Next studies could also focus on a specific comparison, happy leader vs angry leader for instance, and investigate the potential underlying mechanisms. Finally, similarly to the first paper, future research could move from a static perspective with short episodes of emotional expressions to a dynamic perspective, and better understand how different sequences of leaders' emotional expressions could lead to individuals' creative performance and innovation.

The last paper explored as well the emotion-creativity relationship at the interpersonal level, but through the other media of text-based communication. More precisely, not only this research demonstrated that leaders' emotional expressions represent a driver of participation that deserve more attention, but also explained the mechanisms underlying this effect. This research then brings theoretical contributions to crowd science and online community leadership literatures (Beck et al., 2020; Franzoni et al., 2021). However, the specificity of this

empirical study, a special case of crowd-science projects, limitations the generalizability of the findings, as other types of online organizations might demonstrate different results, especially in non-scientific contexts. Therefore, future research should examine if leaders can regulate their emotional displays to keep participation the highest possible.

Overall, this dissertation provides insights about the emotion-creativity relationship from different perspectives and highlights how emotions play a determinant role in shaping creative outcomes. Moving from an intrapersonal perspective in which prior research has already intensively explored the effect of one's emotions on his own creativity, this research moves on a more recent topic and examines from an interpersonal perspective how leaders can use their own emotional expressions to influence other's creativity, in face-to-face interactions or within online communities.

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Dissertation summary

This research explores the emotion-creativity relationship. More specifically, this work explores the effect of emotions on creativity, not only when emotions are experienced by employees at an intrapersonal level, but also when leaders express emotions to employees at an interpersonal level. At the intrapersonal level, prior research has explored intensively how emotions that individuals experience on a daily basis influence their creative performance, explaining their mechanisms and their boundary conditions. However, a scientific consensus is lacking concerning the mechanisms of such relationship. This is why, using a meta-analytic approach, this research aims first to understand the complex relationship between the emotions experienced by employees and their creative performance. Using a meta-analytical approach with 327 independent samples and 158 studies, and following the DPCM (Dual Pathway Creativity Model), this research examines how cognitive flexibility (the ability to switch between various perspectives) and cognitive persistence (the ability to sustain prolonged effort) mediate the impact of emotions on the creativity. Results show that activating positive emotions lead to creativity through cognitive flexibility while activating negative emotions trigger creativity through cognitive persistence.

Even though prior scholars quite explored the effect of emotions on creativity at the intrapersonal level, research about the emotion-creativity relationship is only emerging at the interpersonal level. Leaders' emotional expressions are well known to be a powerful source of influence, and yet, the effect of leaders' emotional expressions on employees' creativity has been poorly investigated. Therefore, secondly, using an experimental approach, this research aims to understand the effect of leaders' emotional expressions on employees' creative performance. This study compares the effect of expressions of ambivalence, happiness and anger. Two online and laboratory experiments show that idea variety and idea quantity increase when employees receive creativity instructions from an angry leader than from a happy leader

(study 1; N=146) decrease when they receive instructions from an ambivalent leader than from a happy leader (Study 2; N=194). In contrast, employees generate more novel ideas with a happy leader than with an angry leader.

Emotional expressions occur not only in face-to-face interactions, but also through text-based communication, and yet, research about their effect on creativity remains rare. Therefore, finally, this research aims at better understand the effect of leaders' emotional expressions on voluntary participation in crowd-science projects. To resolve complex scientific challenges, scientists increasingly collaborate with online communities through text-based communication. However, maintaining a high level of participation in crowd-science projects is difficult. This research is based on Polymath, a crowd-science project where professional and non-professional mathematicians collaborate to solve very difficult problems. Drawing on Emotion As a Social Information (EASI) Theory, we explore the influence of leaders' emotions on subsequent participation with a multi-level count analysis. We find that (1) leaders' positive emotions have a positive relationship through participants' positive emotions with participation's quantity and quality, and (2) leaders' negative emotions have a negative relationship through participants' cognitive complexity.

Résumé de la dissertation

Cette recherche explore la relation émotion-créativité. Plus précisément, ce travail explore l'effet des émotions sur la créativité, non seulement lorsque les émotions sont vécues par les employés à un niveau intrapersonnel, mais aussi lorsque les leaders expriment des émotions aux employés à un niveau interpersonnel. Au niveau intrapersonnel, des recherches antérieures ont exploré de manière intensive comment les émotions que les individus vivent au quotidien influencent leur performance créative, en expliquant leurs mécanismes et leurs conditions limites. Cependant, un consensus scientifique fait défaut concernant les mécanismes de cette relation. C'est pourquoi, en utilisant une approche méta-analytique, cette recherche vise dans un premier temps à comprendre la relation complexe entre les émotions vécues par les employés et leur performance créative. En utilisant une approche méta-analytique avec 327 échantillons indépendants et 158 études, et en suivant le DPCM (Dual Pathway Creativity Model), cette recherche examine comment la flexibilité cognitive (la capacité de passer d'une perspective à l'autre) et la persistance cognitive (la capacité de soutenir un effort prolongé) expliquent l'impact des émotions sur la créativité. Les résultats montrent que l'activation des émotions positives conduit à la créativité par la flexibilité cognitive, tandis que l'activation des émotions négatives déclenche la créativité par la persistance cognitive.

Bien que des chercheurs aient déjà exploré l'effet des émotions sur la créativité au niveau intrapersonnel, la recherche sur la relation émotion-créativité n'émerge qu'au niveau interpersonnel. Les expressions émotionnelles des leaders sont bien connues pour être une source d'influence puissante, et pourtant, l'effet des expressions émotionnelles des leaders sur la créativité des employés a été peu étudié. Par conséquent, dans un second temps, cette recherche qui utilise une approche expérimentale, vise à comprendre l'effet des expressions émotionnelles des dirigeants sur la performance créative des employés. Cette étude compare l'effet des expressions d'ambivalence, de bonheur et de colère. Deux expériences en ligne et en

laboratoire montrent que la variété et la quantité des idées augmentent lorsque les employés reçoivent des instructions de créativité d'un leader en colère plutôt que d'un leader heureux (étude 1 ; N=146) et diminuent lorsqu'ils reçoivent des instructions d'un leader ambivalent plutôt que d'un leader heureux (étude 2 ; N=194). En revanche, les employés génèrent plus d'idées nouvelles avec un leader heureux qu'avec un leader en colère.

Les expressions émotionnelles se produisent non seulement dans les interactions en face à face, mais aussi dans la communication textuelle, et pourtant, les recherches sur leur effet sur la créativité restent rares. Par conséquent, en dernier lieu, cette recherche vise à mieux comprendre l'effet des expressions émotionnelles des leaders sur la participation volontaire à des projets de science par la foule. Pour résoudre des défis scientifiques complexes, les scientifiques collaborent de plus en plus avec des communautés en ligne par le biais de la communication textuelle. Cependant, il est difficile de maintenir un niveau élevé de participation dans les projets de science par la foule. Cette recherche est basée sur Polymath, un projet de science par la foule dans lequel des mathématiciens professionnels et non professionnels collaborent pour résoudre des problèmes très difficiles. En s'appuyant sur la théorie EASI, nous explorons l'influence des émotions des leaders sur la participation ultérieure à l'aide d'une analyse de comptage à plusieurs niveaux. Nous constatons que (1) les émotions positives des leaders ont une relation positive avec la quantité et la qualité de la participation par le biais des émotions positives des participants, et (2) les émotions négatives des leaders ont une relation négative avec la complexité cognitive des participants.